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BIOLOGY AND SYSTEMATICS OF PLUME MOTHS OF THE GENUS *PLATYPTILIA* IN CALIFORNIA¹

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Introduction

MOTHS of the genus *Platyptilia* belong to the family Pterophoridae³ (Alucitidae of European authors) and, in common with the rest of the family, have characteristic fissured wings.

McDunnough (1939) listed thirty species inhabiting the United States and Canada, eighteen of which are known to occur in California (including certain species which have been placed in synonymy in the present paper); four additional species have been recorded, but the author was unable satisfactorily to establish their occurrence in the state. Since this latest list of Lepidoptera, McDunnough has added one species to the list (*P. immaculata* McDunnough), and Lange one species (*P. antirrhina* Lange).

In this paper three additional new species and four new subspecies are presented—further indication of the abundant representation of this group in California.

The genus *Platyptilia* is a cosmopolitan group found from the tropics to the arctic, wherever collections have been made. The North American continent is particularly well represented in number of species.

The food plants of the larvae include many families of plants. Although California species feed chiefly on members of the families Compositae and Scrophulariaceae there are a few that select the families Labiatae and Geraniaceae.

The adults of the genus are very closely related and have presented a great deal of difficulty in classification to those who have not studied them very minutely. Realizing this difficulty, the present writer has attempted to place considerable emphasis on the immature stages as an aid in evaluating properly the morphological characters of the adults. Contrary to previous belief, careful study of the male genitalia reveals good characteristics for specific differentiation. The female genitalia of our California species are of very great specific value in many instances. It is interesting to note that in this

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³ German, Federmotten; French, papillons à ailes en plumes.

genus the divergences noticed in the immature stages are reflected in like divergences in the morphological characters of the adults.

That the biological features of this paper are not complete is apparent, but the little knowledge concerning the group has made it exceedingly difficult to ascertain probable food plants in many instances. These studies suggest that on a morphological basis one can predict the family of plants to which a given species can be assigned, a factor which will be a help in the future study of the biological relationships of the group.

It was found impossible to confine the present study to the group only as it occurs in California, irrespective of the rest of the United States, because the wide distribution of certain species and the necessity of ascertaining the features of the entire United States and Canadian fauna in order to describe new species adequately became very apparent as the study progressed. Certain European material has been examined, and in two instances species in this hemisphere which have been going under European names were found to be very closely related to, but distinct from, the European species. The present writer has examined all but two of the species which have been reliably recorded from the United States and Canada.

An explanation concerning the method of citing localities under each species may be desirable. In the commoner species, where few taxonomic difficulties have been encountered, the usual procedure has been to list the counties where infestations have been found and the months when the collections were made. In other cases, where new interpretations are made of species or where the species is rare and new localities are found, complete data as to locality, date, and collector are presented.

HISTORICAL BACKGROUND

The writer has found no work dealing entirely with the genus *Platyptilia*, outside of smaller papers which include descriptions or biologies, and so the historical background is for the most part, and most particularly in the earlier works, associated with general treatises of Lepidoptera or at most a treatment of the entire family. I have drawn freely from Fernald's (1898) excellent account of the early historical background of the family in presenting the following chronologically arranged synopsis of the history associated directly or indirectly with the genus *Platyptilia*.

Although certain authors before Linnaeus figured or described plume moths, their work is of only historical interest as the tenth edition of Linnaeus' "Systema Naturae" has been adopted as the starting point in zoological nomenclature.

Linnaeus (1758) established the genus *Alucita* for the plume moths under the heading *Alucitae* and included the following species: *monodactyla*, *didactyla*, *tridactyla*, *tetradactyla*, *pentadactyla*, and *hexadactyla*.

Poda von Neuhaus (1761) adopted the generic name *Alucita* with *pentadactyla* L. the only included species.

Geoffroy (1762) rejected the name *Alucita* of Linnaeus and erected the genus *Pterophorus* and placed under it these species: *pentadactyla* L., *didactyla* L., and *hexadactyla* L.

Scopoli (1763) listed five species of plume moths under the genus *Phalaena*.

Fabricius (1775) made improper use of the genus *Alucita* when he used it for certain tineids, and followed Geoffroy (1762) in using *Pterophorus* for the plume moths.

Latreille (1796) separated *hexadactyla*, establishing for it the genus *Orneodes*, retaining the rest of the plume moths in the genus *Pterophorus*.

Hübner (1805 or 1806) placed the plume moths in Phalanx 9, with two divisions under it, the *Pterophorae* and the *Ripidophora*.

Haworth (1803-1828) used *Alucita* in the Linnaean sense for the plume moths.

Hübner (1816-1826) erected the genera *Platyptilia* and *Amblyptilia* for the family Obtusae of his second tribe of plume moths.

Curtis (1823-1840) established the genus *Adactylus* with *adactyla* Hüb. as type, adopted the genus *Pterophorus* with *pentadactyla* L. as type, and the genus *Alucita* with *hexadactyla* L. as type.

Curtis (1829) used the name *Adactylus* for the species of plume moths with undivided wings, *Alucita* for "*hexadactyla* and allies," and *Pterophorus* for the remaining species.

Treitschke (1825-1835) used *Alucita* to include species previously placed under *Agdistis* and *Pterophorus*, and used *Orneodes* for *hexadactyla* and its allies.

Zeller (1841) published a monograph of the plume moths in which under *Pterophorus* he included *Platyptilus* (*Platyptilia* Hübner) as one of his groups or subgenera.

Zeller (1852) revised the plume moths reducing to synonymy his genus *Adactyla* and adopting Hübner's *Agdistis*.

Fitch (1854) described two species of *Platyptilia* and listed eight species of plume moths from New York. He was apparently the first writer to publish on North American plume moths.

Wallengren (1860) published an important paper in the classification of these insects. He followed Zeller, dividing them into the Pterophoridae and the Alucitina, and under Alucitina he adopted the genus *Alucita* for *hexadactyla*. His work is reviewed by Jordan (1869).

Riley (1869) described the artichoke plume moth, *Platyptilia carduidactyla*, reared from thistles in Missouri.

Packard (1873) described three species of plume moths from California, placing them in the genus *Pterophorus*.

Walsingham (1880) presented the most important paper on North American plume moths up to this date, and described eleven new species which are now included in the genus *Platyptilia*.

South (1880-1885) presented a series of papers on British plume moths in which he described many of the immature stages and life history notes of members of the genus *Platyptilia*, giving excellent illustrations.

Fish (1881) described *Platyptilia albicans* from Nevada and *P. edwardsii* from Massachusetts.

Meyrick (1890) presented an important paper on the European Pyralidina which included a discussion of the origin of the Pterophoridae.

Tutt (1895) presented a monograph of the British plume moths, which includes valuable information on the life history of many *Platyptilia* species.

Hofmann (1895) presented a good account of the genitalia and described the immature stages of plume moths in so far as they were known.

Fernald (1898) monographed the plume moths of North America and placed the classification of these moths on a much firmer basis.

Tutt (1905) attempted to fix the types of Pterophoridae in an important paper.

Grinnell (1908) described four species of *Platyptilia* from California, three of which have subsequently become synonyms. This paper again emphasized the abundant representation of Pterophoridae in California.

Fletcher (1909) presented an excellent account of the plume moths of Ceylon.

Meyrick (1910) gave an excellent account of plume moth genera in "Wytsman's Genera Insectorum."

Barnes and Lindsey (1921) made the most important contribution to the knowledge of North American Pterophoridae in their study of the plume moths of America north of Mexico.

Since 1921 there have been no major papers dealing with North American Pterophoridae, but a few of the more important papers which deal indirectly with our fauna, give life history information, or describe new species, are listed below.

Fletcher (1921, 1932) presented sections in his study of Indian insects that included information on *Platyptilia taprobanes* Felder, a species which occurs in Florida and California.

Lindsey (1924) in a paper dealing with the neururation of the family Pterophoridae revised his ideas of phylogeny of the genera.

Braun (1925, 1930) described the partial life history of *Platyptilia fragilis* (Walsingham).

McDunnough (1927) presented a valuable paper on Canadian plume moths which included certain species that occur in California.

Day (1928) described the early stages of *Platyptilia punctidactyla* (*pica* Walsingham ?) in British Columbia.

Pierce (1938) described the genitalia of the British Pterophoridae.

Lange (1939, *a*, *b*) presented the partial life histories of two plume moths in the genus *Platyptilia* and described one new species in the genus.

Fletcher (1940) found our Californian *Platyptilia acanthodactyla* Hüb. to be distinct from the European, and described it as *P. crataea*.

Lange (1940) named a new *Platyptilia* from Alaska.

Collection and Preservation of Material

Most of the adults from California studied in the present paper have been reared from larvae or pupae collected on the larval food plants. This procedure makes it possible to obtain specimens in good condition, which is essential in this particular group. Adults were pinned either on minuten or on number 1 or 2 pins, with the wings spread.

Adults were also collected at light or flushed from foliage at night using a pole and a Coleman lantern. The usual procedure in handling the specimens is to place only one adult at a time in the cyanide bottle. When it drops to the bottom of the jar, immediately remove and transfer it to a small cellophane or glassine bag with the wings folded over the back. The bag is then placed in a large cyanide bottle until the insect is dead. This method allows the specimens either to be mounted immediately or relaxed later on; the wings can be spread more easily and, in addition, the specimen remains in good condition.

Approximately 144 genitalia mounts have been made in this study, often including 20 or more in a single species where considerable difficulty was experienced in finding constant morphological distinctions.

These steps were followed in preparing the genitalia for study:

1. The entire abdomen in the female and terminal portion in the male were boiled for 15 to 30 minutes in KOH (10%).
2. Distilled water was used to wash and clean off hairs.
3. Parts were dehydrated in glacial acetic acid for 30 minutes.
4. Oil of cloves was used to clear, 15 minutes.
5. Structures were mounted in balsam on slide. Male structures were spread and aedeagus removed to one side; female structures were mounted using bits of cover glass to support the cover and avoid crushing parts.

Larvae of all the species available were prepared by making a longitudinal incision through the skin, using two specimens, one slit dorsally, the other ventrally, and treated by the method used for the genitalia. In this manner, the finer structures and surface markings of the integument were made available for study.

Pupae were prepared in the same manner. Even pupal cases were found to be of value when cleared and the structures teased apart so that they could be studied from the desired angle.

Field methods. The most satisfactory method for preserving larvae as they were collected in the field was to drop them into boiling water, then transfer to 70 per cent ethyl alcohol.

A satisfactory method used for rearing out adults from larvae and pupae in the field was to place the immature stages in widemouthed Mason jars with perforated tops to allow for the entry of air. New food was added from time to time and the larvae pupated on the foliage or on the sides or tops of the jars.

Terminology

This paper makes many references to locations of structures or areas of the wings. Some of these perhaps not readily understood are shown in figure 1.

In the description of the male and female genitalia the terminology follows that used generally by lepidopterists, but it seems desirable to list alphabetically the terms used and, where possible, their equivalents as given by Snodgrass (1935), and Torre Bueno (1937). The exact homologies of the juxta (basal plate?) and the anellus lobes have not been adequately presented as far as the writer is aware, and Snodgrass does not attempt to ascertain their relationships. In certain instances the terms have special usages in this family of moths, and an attempt is made to present these divergences.

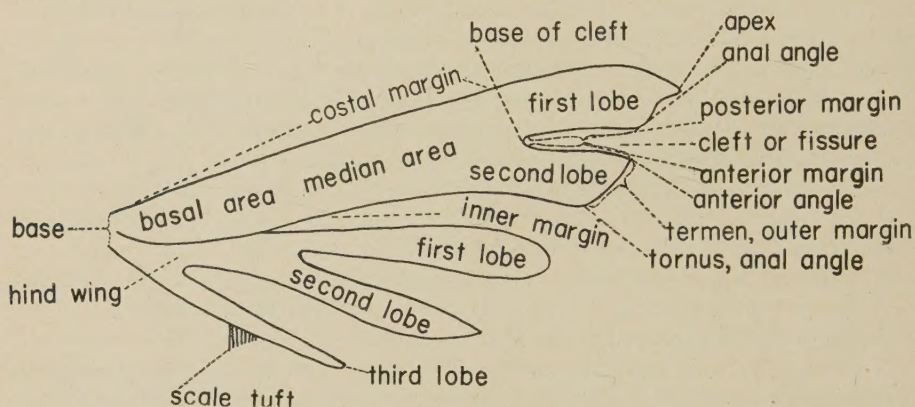


Fig. 1. Terminology used in the description of the wings.

Aedeagus.—The central intromittent organ, having an eversible endophallic tube often longer than the aedeagus. The proximal part of the phallus is not differentiated. The aedeagus is fastened proximally to the point of union of the two anellus lobes, or above the so-called juxta, and swings in an arc through an opening between the two anellus lobes.

Anellus.—Two sclerotized lobes, sometimes variously forked, that support the terminal part of the aedeagus and attach proximally to a triangular juxta or basal plate. The anellus, as used in this case, is not exactly a sclerotization of the inner wall of the phallocrypt or phallosheca. It often forms a ring or tube about the base of the aedeagus (as given by Snodgrass) as the base of the aedeagus in this group lies free. The anellus lobes as used here do not surround the aedeagus, but act as supporting arms.

Anterior apophyses.—In the female, the pair of slender sclerotized rods that extend cephalad from the ninth abdominal segment and serve for places of muscle attachment.

Bursa copulatrix.—In the female, the sac-like structure at the distal end of the ductus bursae, from which a tube connects with the genital chamber (vagina). In this group the proximal portion of the ductus bursae is enlarged and sclerotized to form a copulatory pouch, and there is no evidence that the bursa copulatrix acts as a pouch to receive the aedeagus.

Costa of harpe.—In the male Lepidoptera, the dorsal part of the harpe.

Cucullus of harpe.—In the male Lepidoptera, refers to the terminal part of the harpe, often a hook-like process.

Ductus bursae.—The duct, in the female Lepidoptera, which extends from the ostium to the bursa copulatrix. In this group it is strongly chitinized proximally, often forming a pouch for the reception of the male aedeagus.

Genital plate.—A sclerotized median plate extending posteriorly from the ventral plates of the seventh abdominal segment in the female, and on which the female copulatory opening emerges. In this group the plate is not greatly developed, in some cases consisting of several median lobes.

Harpe.—The movable genital claspers in the male used to hold the female during copulation. Snodgrass refers to them as homologous with the harpagones (stylus derivatives) in most Lepidoptera, and in others to parameres, depending upon the origin of the muscles. Mitchener (verbally to the writer) is inclined to refer to them as gonocoxites of the ninth segment, believing that the stylus derivatives in certain Trichoptera are lost entirely and that as a result the harpes cannot be stylus derivatives.

Juxta.—A median plate in the male which terminally gives rise to the anellus lobes, and to which the aedeagus is attached by an arm of its base. In this group no close connection between the juxta and the harpes was found, and so the juxta as used in this group is not homologous with the basal plate of Snodgrass as found in *Carpocapsa*, although it seems to bear the same relationship.

Lobe of ovipositor.—One of a pair of lobe-like structures composed of the ninth and tenth segments which make up part of the "ovipositor" in female Lepidoptera and are used to place the eggs.

Ostium (ostium bursae).—The genital opening of the female Lepidoptera, arising from the seventh abdominal segment and leading to the bursa copulatrix by the ductus bursae. It is the equivalent of the vulva of female insects which have the genital opening on the eighth segment.

Posterior apophyses.—In the female, the more anteriorly placed pair of slender, chitinized rods that extend cephalad within the abdomen from the eighth abdominal segment and serve for muscle attachment. In this group this pair of rods are very greatly reduced, sometimes practically absent, and are more heavy set than in most other Microlepidoptera.

Sacculus of harpe.—The basal portion of the harpe in the male.

Saccus.—A median projecting process of the vinculum in the male, which in this group projects posteriorly over the bases of the harpes.

Signum (a).—The spine-like processes inside the bursa copulatrix of the female. In this group the signa are spine- to thorn-like and are well developed.

Tegumen.—The ninth tergum in the male, whose coxosternal arc is the vinculum.

Uncus.—A tergal structure of the tenth segment in the male, usually hook-like in this group, lying above the anus and used in holding the female during copulation.

Vinculum.—The coxosternal arc of the ninth segment in the male, giving rise to a median basal projection, the saccus, which overlaps the bases of the harpes.

The Genus *Platyptilia* Hübner

TAXONOMY

The genus *Platyptilia* was erected by Hübner in 1825 in his "Verzeichniss bekannter Schmetterlinge" which was a work of 431 pages written from 1816 to 1826. It is not within the scope of this paper to decide upon the limitations of the genus and whether it should be divided (as recent British workers have done) into several genera chiefly on the basis of genitalic differences; or whether it would be best to utilize the names available to make subgenera.

The genus *Amblyptilia* Hübner, which Meyrick lists as a synonym of *Platyptilia*, would include our *pica* Walsingham complex in North America. The typical genus *Platyptilia* as used by Pierce (1938) would include certain of our typical composite feeders such as *carduidactyla* Riley, *williamsii* Grinnell, and others. The other genus mentioned by Pierce, *Euenemidophorus*, would include *rhododactyla* Schiffermüller, which has been introduced into this country presumably on roses.

If we start erecting genera we would also be compelled to separate *fuscicornis* Zeller, which is distinct both biologically and morphologically from any of the other species. The two species, *taprobanes* Felder and *antirrhina* Lange, would also merit distinct generic rank if we were to carry this plan out. The large group of species with the hooked cucullus of the harpes, such as *shastae* Walsingham, and *albiciliata* Walsingham, would also have to be placed in a separate group.

All of this differentiation seems to indicate that the erection of separate genera for the diversification within this group of plume moths defeats the entire theory of our classification, and that, at most, subgeneric categories should be utilized in showing the differentiation. Lepidopterists as a whole are more inclined to separate out genera on much less evidence than is indicated in this group. Therefore, until the genotypes of all the European and other material can be examined, it is best to let our California material remain in the single genus *Platyptilia* Hübner.

Meyrick was perhaps one of the few individuals to have a knowledge of the group from a world-wide viewpoint, and so I am following him in listing the synonymy below, and have added several erected since his compilation (see Meyrick, 1910). Barnes and Lindsey (1921) also included all of our North American species in the single genus, *Platyptilia*.

The list below presents a compilation of the synonymic and subgeneric citations of the genus *Platyptilia* of Hübner.

GENUS *PLATYPTILIA* HÜBNER

(Greek: *platys*, πλατύς, broad, flat, wide; + *ptilon*, πτελον, feather or wing.)

Platyptilia Hübner, 1825, Verz. Bekannt. Schmett. (27), p. 429; Logotype: *Alucita gonodactyla* Denis & Schiffermüller (cited as type by Tutt, 1905, Ent. Rec., 17:35). (See plate 6, fig. c.)

Platyptilus Zeller, 1841, Isis (Oken), 1841, p. 764 (new name for *Platyptilia* Hübner).

Amblyptilia Hübner (also as *Ampliptilia* in error), 1826, Verz. Bekannt. Schmett., p. 430; Logotype: *Alucita acanthodactyla* Hübner (cited as type by Tutt, 1905, Ent. Rec., 17:35).

- Cnaemidophorus* Wallengren, 1860, Skand. Fjäd. in K. svenka Vetensk Akad. Handl. (N.F.) 3 (6):10; Haplotype: *Alucita rhododactyla* Denis and Schiffermüller.
- Cnemidophorus* Zeller, 1867, Stett. ent. Zeit., 28:332 (emendation).
- Crocynoscelus* Walsingham, 1897, Ent. Soc. London Trans., 1897 (Apr.):35-36; Orthotype: *Crocynoscelus ferrugineum* Walsingham.
- Eucnemidophorus* Wallengren, 1881, Ent. Tidskr., 2:96 (new name for *Cnaemidophorus* Wallengren, preoccupied).
- Fredericina* Tutt, 1905, Ent. Rec., 17:37 (*nomen nudum*); *ibid.*, 1906, Brit. Lep., 5:161; Orthotype: *Alucita? calodactyla* Schiffermüller.
- Gilbertia* Walsingham, 1891, Ent. Mo. Mag., 27:259; Orthotype: *Gilbertia eques* Walsingham.
- Gillmeria* Tutt, 1905, Ent. Rec., 17:37 (*nomen nudum*): Orthotype: *Alucita? ochrodactyla* Denis and Schiffermüller.
- Platyptiloides* Strand, 1913, Arch. Naturgesch., 78 (A 12):65; (desc. as new subgenus of *Platyptilia*); Haplotype: *Platyptilia (Platyptiloides) albisignatula* Strand.
- Sochchora* Walker, 1864, List Lep. Ins. Brit. Mus., 30:952; Haplotype: *Sochchora donatella* Walker.
- Walsinghamiella** (n.n. pro *Gilbertia* Walsingham 1891) Berg, 1898, Comun. Mus. nac. Buenos Aires, 1 (no. 2):42.

The characterization of the genus *Platyptilia* Hübner is presented as follows: Front rounded or conical, usually with a well-developed tuft of scales. Ocelli obsolete. Tongue developed. Labial palpi slender, usually exceeding front, obliquely ascending; third segment short, filiform. Maxillary palpi obsolete. Tibiae simple or with tufts of scales at origin of spurs and center of middle tibiae. Forewings cleft from two thirds to three fourths from base; anal angle usually prominent, may be retreating in certain species; Cu_2 separate, extending to anal angle; Cu_1 separate, extending to about center of second lobe; M_1 and M_2 obsolete, M_3 developed; R_1 , R_2 , R_5 separate; R_3 and R_4 stalked. Hindwings trifid; third lobe usually with a patch of dark scales on inner margin, sometimes absent; Cu_2 extending to beyond center of inner margin of second lobe; Cu_1 extending to anal angle; Sc and R separate, diverging on first lobe; M_3 stalked basally with Cu , extending to anterior margin of second lobe.

The genus *Platyptilia* is close to *Stenoptilia* as was presented by Meyrick (1910); perhaps no clear-cut distinction can be made. As far as our species are concerned, however, *Stenoptilia* refers to those species having the lobes of the forewings very slender, with the anal angle retreating, and no black scales along the inner margin in the third lobe of the secondaries.

Distribution. The genus *Platyptilia* is well distributed in all parts of the world, and with more intensive collecting the number of known species will undoubtedly increase. Species have been found from the tropics to the arctic regions, indicating that the group has been able to adapt itself to life under a great range of climatic conditions. All evidence points to the fact that the family Pterophoridae arose early in the history of the Pyralidina. This hypothesis seems to be well borne out in this genus, whose range indicates that it has early had opportunity to spread to all major continents.

The numbers of species which are known up to the present time for the various localities are presented below. They have been compiled from Meyrick (1910) and the Zoölogical Record (1910-1945). In many instances the same species occur in more than one locality, but no attempt is made in this list

* Neave, 1940, Nomenclator Zoölogicus, vol. IV:651.

to separate these out. Approximately 202 species have been recorded from the world. All but two species found in Canada occur in the United States. The North American continent has 17 per cent of the world species. In California we find 22 species, about 71 per cent of those recorded from the United States.

WORLD DISTRIBUTION OF *PLATYPTILIA* SPECIES

LOCALITY	NUMBER OF SPECIES	LOCALITY	NUMBER OF SPECIES
North America:		Mauritius Island	1
California	22	Reunion Island	1
United States (including California)	31	Seychelles Island	1
Alaska	2	Eastern Siberia	1
Canada	15	Sakhalin Island	1
West Indies	1	Japan	11
Costa Rica	2	China	2
South America	31	Formosa	1
Hawaiian Islands	7	India	15
Canary Islands	1	Ceylon	6
Europe	23	Java	3
Asia Minor	4	New Guinea	2
Asia	4	Bismarck Island	1
Syria	1	Australia	3
Africa	40	Tasmania	1
Principe Island	1	New Zealand	13
San Thome Island	1	Chatham Island	1

BIOLOGY

The majority of the known food plants of the larvae, from a world standpoint, belong to the families Compositae, Scrophulariaceae, and the Labiatae, although other families of plants are selected. Other plant families which have been recorded include the following: Begoniaceae, Caprifoliaceae, Geraniaceae, Lentibulariaceae, Primulaceae, Ranunculaceae, and Rosaceae. Tutt (1898, p. 7) listed Leguminosae for *Platyptilia acanthodactyla* Hübner.

The eggs, laid singly, are usually smooth and ovate, and are left exposed on the leaves, flowers, or other parts of the plants. The composite feeders in general have larvae that bore inside the stems, flower structures, or green seeds, whereas the others are more or less external feeders on the terminal shoots on leaves or feed into the flowers or green seeds when they are present. The pupae are usually naked, or may have a slight cocoon, and are fastened by the posterior end to the plants.

In general the life history is completed above ground, and in localities where overwintering is necessary the adults usually hibernate and start new infestations when weather conditions are again favorable.

The larvae are characterized by slender stalk-like prolegs, and many have numerous apically swollen secondary setae covering the body. Pupae of this genus are angulate and have two areas for attachment on the posterior end. The adults are rather weak fliers, hold the wings horizontally or obliquely, and have a characteristic manner of flitting the wings up and down.

The typical life history, as exemplified by the species studied by the writer, would indicate a group of southern origin which is not well adapted to prolonged aestivating or hibernating habits.

The Genus *Platyptilia* in California

DISTRIBUTION

Members of the genus *Platyptilia* in California are found from the Lower Sonoran life zone to the Boreal zone. This is an indication of their successful adaptation to a wide range in climatic conditions.

A few species, chiefly *fuscicornis*, *pallidactyla*, *carduidactyla*, and *williamsii*, have a rather general distribution, although they do not extend far into the Boreal zone. The coastal area of California accounts for a good third of the species; another third is found in the higher mountains of the Coast Range and Sierra Nevada. *Platyptilia maca*, *albida*, and *pica sierrae* are found in high mountain meadows in California, chiefly in the Boreal zone. A few species, such as *immaculata* and *lutescens*, are found in inland desert ranges; and *taprobanes* and *bifida* came into California from the south.

The limiting factor in the distribution of the group seems to be the presence of a food plant during the dry season of the year, as members of this group are not adapted to aestivating habits. For this reason perennial plants are usually the food plants, with the annuals acting as food plants only during limited periods. The hibernation habits in the higher mountains are not known, but apparently moths are able to live for months at a time when the temperature is low. The perennial nature of many plants along the coast of California, and the more humid conditions which allow the food plants to grow practically all year around, accounts for the great number of species found in this region.

BIOLOGY

A most distinctive feature of the biology of the *Platyptilia* species which have been studied is the presence of numerous overlapping generations a year. These occur chiefly on perennials in the plant families Compositae and Scrophulariaceae.

Although the chief food plants of *Platyptilia pica* belong in the family Scrophulariaceae, the larvae also feed on members of the Geraniaceae and Primulaceae. This diversity of larval food plants is also found for *Platyptilia punctidactyla* Haworth (*cosmodactyla* Hbn.) in England (Tutt, 1898), a species closely related to *pica* Walsingham, as it selects members of the families Scrophulariaceae, Labiatae, Geraniaceae, and Ranunculaceae. Here we have a range in selection from one of the least complex plant families to one of the most complex.

The eggs of the California species are laid singly on the host plants, usually on the underside of the leaves or on the flower or fruit structures. They are elongate-oval, and smooth or reticulated. In one instance, namely *P. fuscicornis*, the egg is truncate on one end with a row of tubercles. The snapdragon plume moth, *P. antirrhina*, has the surface of the egg distinctly reticulated. The larvae are borers inside the stem or flower parts, or are external feeders, webbing the leaves and terminal shoots. Pupation occurs any place on the plants, but usually the pupa is naked and attached by the anal end. Usually the entire life history is completed above ground, although larvae can bore into the crown of the plants, as in the case of *carduidactyla*.

ECONOMIC IMPORTANCE

We have in California five species whose larvae cause injury of economic importance, namely *carduidactyla*, which attacks artichoke and cardoon; *williamsii*, on calendula; *fuscicornis*, on sages which are important sources of nectar for honeybees; *antirrhina*, which damages snapdragons; and *pica* (varieties), which occasionally feed on snapdragon or *Pelargonium* spp. The other species that have been studied feed on native or introduced plants that are considered of little economic importance to California agriculture.

The artichoke plume moth *P. carduidactyla*, at times causes severe damage to artichoke heads, and the economics of this species can be referred to in the article by Lange (1941). Often the snapdragon plume moth, *P. antirrhina*, causes severe injury to snapdragon plants, especially in nurseries. Reference to the damage caused by the other species can be found in the biological discussion presented under the individual species involved.

PHYLOGENY

The California species of *Platyptilia* show two major trends of speciation toward adaptation to food plants, one to the family Compositae and the other to the family Scrophulariaceae. It is interesting to observe that these two families are the most successful groups of flowering plants today, and are probably those most suited to continue in future epochs. The more highly organized group of plants of the two groups mentioned is usually considered to be the Compositae, although the Scrophulariaceae also exhibit great complexity.

The group of species associated with the Compositae is distinct biologically and morphologically from the group feeding on the Scrophulariaceae. The former are for the most part internal borers in the stems, petioles, flowers, or seed structures of the plants they select. Morphologically the male genitalia show many similarities, and there are other structures, such as the presence of a tuft of scales on the third feather of the secondaries, which isolate this group as a unit.

On the other hand, the group of species associated with the family Scrophulariaceae are for the most part external feeders on the leaves, although certain species can bore into the stems or feed into the flower structures. This group shows a greater diversity both biologically and morphologically than does the group associated with the composites. One group of this complex is exemplified in *Platyptilia pica* and its forms in the United States, which selects plants of the genera *Castilleja*, *Mimulus*, *Scrophularia*, *Stachys*, and others in the family Scrophulariaceae, and is closely related to the European species, *P. punctidactyla*. One of the forms of *pica*, namely *crataea*, has been observed to feed occasionally on members of the family Geraniaceae (*Pelargonium* sp.), and Day (1928) found *pica* on a member of the Primulaceae (*Dodecatheon* sp.). One species, *P. fuscicornis*, has gone over to the mint family, Labiatae, especially the genus *Salvia*, and shows a diversity both in structure and in biology. The dorsal processes of the pupa, however, indicate the close relationship of *fuscicornis* to *pica*. Another unit consists of the *albiciliata* and *albida* complex, which is a group selecting members of the

genus *Castilleja*. These species feeding on *Castilleja* are difficult to classify and it is interesting to note that from a taxonomic standpoint the plant genus *Castilleja* is also very difficult to classify. *P. fragilis* is apparently a *Pentstemon* feeder and seems to form another unit in itself. *P. antirrhina* and *P. taprobanes* seem to form a separate group both morphologically and biologically.

The bionomics of the other members in the group feeding on Scrophulariaceae are not known well enough to venture any decisions as to biological

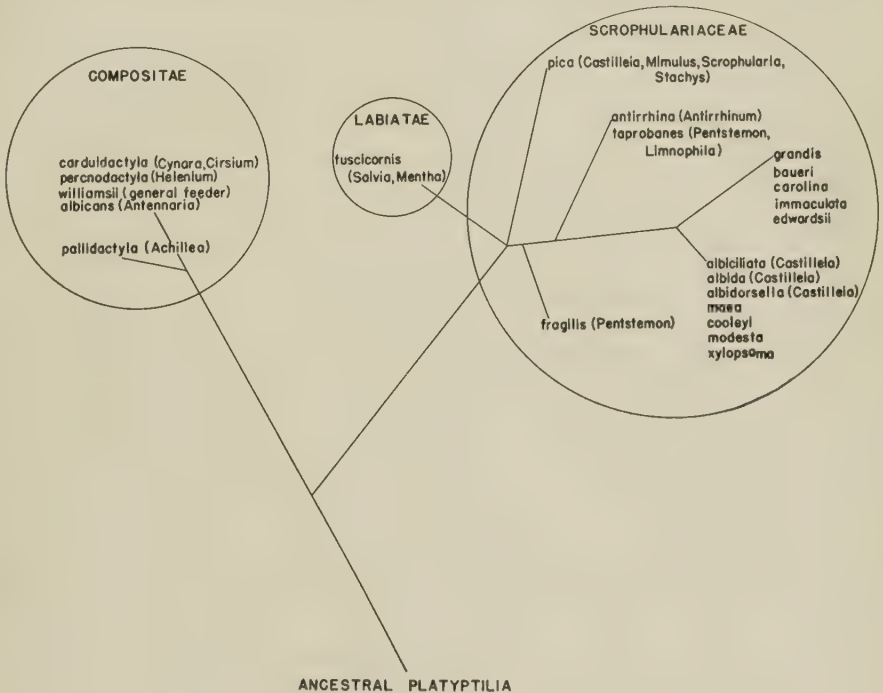


Fig. 2. Phylogeny of the California species of the genus *Platyptilia*.

grouping, but certain species fall into other groups morphologically. For example, *carolina*, *grandis*, and perhaps *immaculata* and *baueri* seem related, and *albidorsella* and *maea* fall into a related group. Perhaps we can venture that *modesta*, *cooleyi*, and *xylopsamma* show relationships.

It is difficult to draw any conclusions as to the epoch during which the Pterophoridae showed diversification toward the two families of plants already discussed, as not only is the origin of the plant groups somewhat in doubt, but in addition we have no available fossil records of the insects to assist us. The present diversity and close affinity of many species, together with its development on plants of high organization, would seem to indicate a more recent organization for the Pterophoridae although the ancestral types could have arisen quite early. Meyrick (1910) in discussing the Pterophoridae stated: "The family is an aberrant group of the Pyralidina, with some relation to the Oxychirotidae, Orneodidae, and Pyraustidae, but no close or

obvious connection with any of these, the indications of affinity being merely general. It probably originated early in the history of the Pyralidina, and its ancestral forms are apparently extinct."

The fact that the ancestral forms of the group are not known makes it in the realm of speculation to decide whether the ancestors of our species fed on members of the family Scrophulariaceae or Compositae. The presence of a scale tuft on the dorsal margin of the third feather of the secondaries as an indication of more advanced species, as given by Meyrick (1910), does not seem to assist in tracing the early phylogeny since in the *pica* group, and in *antirrhina* and *fuscicornis*, we have groups with a well-developed scale tooth comparable to the composite feeders. It would seem that regardless of the ancestral host, there apparently was a quite early divergence along two main lines, one to the Scrophulariaceae, the other to the Compositae, with a secondary divergence and specialization, especially in the former group. The phylogeny is portrayed in figure 2.

ANALYSIS OF SYSTEMATIC CHARACTERS

The present study has indicated that the male and female genitalia possess the most reliable characters for the separation of species in this group, although in certain instances the female structures are more valuable than those of the males. In certain groups the male genitalia are very similar, and in these cases the length and shape of the aedeagus and the shape of the uncus have been especially valuable.

In the study of genitalia it must be realized that considerable variation occurs and that single slides of these parts are only indications. The writer has made twenty or more slides in a single species where difficulties were encountered.

Other characters which are of value for specific segregation are the tufting and relative length of the frontal tuft, the coloration and shape of the wings, the position of the scale tuft on the hindwings, and the color and tufting of the legs.

In one instance, namely, certain specimens of *albida* and *albidorsella*, where a convergence of color pattern occurred, and no other external differences could be found, the genitalia had to be employed to give a positive check on the species involved.

The immature stages give excellent separating characters. In certain instances the eggs alone will readily separate the species involved. The setal formulae of the larvae are good indices for specific differentiation, and in one case, the complex *albida*, *albiciliata*, and *shastae* species were separated on the shape of the front of the pupa.

An attempt was made to find characters of the genitalia which could be measured and evaluated mathematically so that an index of distinctness could be more easily determined. In the males, a careful measurement of the different genitalic features showed that the most constant, or least variable features were the length of the valves, width of the saccus, length of the aedeagus and length of the anellus lobes. Other features are perhaps just as valuable, but the difficulty of measuring the width of the uncus, for example, in a slide mount where this structure is often turned, is readily apparent.

The results of these measurements indicated that in cases where the external features of the adults are very close, especially in the group feeding on *Castilleia*, there is also such a great variation in the structures of the male and female genitalia that even careful measurements fail to give substantial differences. In certain of these cases, it was found that in the male genitalia, the shape of the uncus alone will suffice to separate species, but this was not a feature capable of being measured in order to give a mathematical variation.

It is interesting that in the case of *fragilis*, where the adults are difficult to separate on the basis of external features from forms of *albiciliata* and *lutescens*, the species can be readily separated by the genitalia, and these differences are exemplified in measurements. In certain cases identical measurements were obtained for totally unrelated forms.

The genitalic features have another value, that is, as an aid in ascertaining the food plants of the larvae. In all the composite-feeding forms, for example, the harpes of the male genitalia are simple blade-like structures, whereas the moths feeding on Scrophulariaceae have a hook-like structure or cucullus on the terminal portion of the harpes. The sage-feeder, *fuscicornis*, has a structure different from any of the others in the genus. In the females the majority of the composite feeders have the ostium arising in the center or on the left side, whereas the forms feeding on Scrophulariaceae have the ostium arising on the right side. Exceptions to this latter statement are found in *antirrhina*, *taprobanes*, and *fuscicornis*, which in addition show other differences.

Separation of adults. The great variation and intergradation in coloration and markings occurring in certain species in this genus are so great that a key based on superficial features that will fit all of the specimens has proved to be an impossible goal. It is thought, however, that the key will fit a majority of the specimens in the genus, and that genitalic mounts and more careful scrutiny under the microscope may be necessary for the specimens which cannot be definitely placed.

In the case of the numerous subspecies of *pica* (Walsingham), the key is based on typical specimens. The great variation in this group, even in the same locality, makes it almost impossible to determine single specimens on the basis of color pattern.

KEY TO THE CALIFORNIA SPECIES OF *PLATYPTILIA*

1. Frontal tuft greatly elongated, conical, as long as or longer than eye; frons (front) produced anteriorly as a conical projection (seen when scales are removed) *pallidactyla* (Haworth)
Frontal tuft usually distinctly shorter, blunt or bifid; frons, if produced, is not conical; doubtful specimens have the usual triangular mark on primaries well developed 2
2. Scale tuft present on third feather (lobe) of inner margin of secondaries 3
Scale tuft absent, or only weakly indicated, on third feather of inner margin of secondaries 16
3. Scale tuft on inner margin of third feather of secondaries located at $\frac{2}{3}$ the distance from base of feather; second palpal segment with an enlarged apical tuft of scales *fuscicornis* Zeller
Scale tuft at end, just before center, or just beyond center of feather 4
4. Scale tufts arising from just before center or just beyond center of inner margin of secondaries 5
Scale tuft at end of inner margin of secondaries 8
5. Scale tuft on inner margin of third feather arising from just before center; apices of primaries not greatly produced 6
Scale tuft on inner margin of third feather of secondaries arising from just beyond center; apices of primaries produced, distinctly acute 11
6. Scale tuft on inner margin of secondaries prominent, triangular; color of primaries buff-brown *carduidactyla* (Riley)
Scale tuft reduced, with scales of equal length, or slightly triangular 7
7. Frontal tuft conical, reaching almost to end of palpi; color buff-brown *percnodactyla* (Walsingham)
Frontal tuft short, truncate; palpi project noticeably beyond anterior margin of frontal tuft; color grayish with black markings *williamsi* Grinnell
8. Small species, 9 to 19 mm. wing expanse; a small triangular scale tuft near end of third lobe of secondaries 9
Larger species, 10 to 27 mm. wing expanse; scale tufts not triangular, composed of scales of about equal length 10
9. Small, with wing expanse of from 9 to 16 mm.; body with scaling smooth; color brownish gray *taprobanes* (Felder)
Larger, wing expanse from 15 to 19 mm.; body with scaling rough; color grayish brown to fuscous *antirrhina* Lange
10. Frontal tuft wide in front, notched at center; scale tuft on end of third lobe of secondaries, composed of an extensive group of scales of approximately equal length *baueri* Lange
Frontal tuft more rounded, not notched at center; scale tuft inconspicuous *albidorsella* (Walsingham) [in part]
11. Color of primaries chiefly white and black; abdomen white, with characteristic black dashes *pica pica* (Walsingham)
Color of primaries darker shades of brown and gray, or body with a dark background 12
12. Color of primaries ranging from shades of light reddish brown to dull, smoky brown
Color of primaries brownish gray to gray 13
..... 15
13. Primaries light brown to grayish brown with distinct costal dotting and scattered lighter scales *pica calisequoiae* Lange
Primaries mostly of uniform shades of reddish brown to smoky brown with little lighter irroration 14
14. Primaries light grayish brown to reddish brown; habitat, southern California *pica monticola* Grinnell
Primaries dull, smoky brown; habitat, central coastal California *pica crataea* Fletcher

15. Expanse of primaries ranges from 14 to 21 mm.; uniform grayish with little indication of costal dotting and basal oblique dashes; habitat, mountains of California in Transition and Boreal life zones.....*pica sierrae* Lange
 Expanse of primaries ranges from 20 to 25 mm.; brownish gray with costal margin dotted and basal, oblique, lighter dashes present; habitat, coast of northern California*pica marina* Lange
16. Frontal tuft notched (bifid) at center on anterior margin..... 17
 Frontal tuft not notched..... 18
17. Primaries creamy white, except for smoky dot at base of cleft
immaculata McDunnough
 Primaries grayish brown, with a dark spot at base of cleft, and indistinct lighter streaks through lobes.....*bifida* Lange
18. Triangular mark on primaries well developed..... 19
 Triangular mark on primaries absent or indicated only by a darker spot or dash at base of cleft..... 25
19. Size large, wing expanse of from 35 to 36 mm.....*grandis* (Walsingham)
 Size smaller, wing expanse not over 29 mm..... 20
20. Black scale tufts on inner margin of primaries usually absent, although scattered dark scales may occur..... 21
 Black scale tufts (usually two) present on inner margin of primaries..... 22
21. Primaries deep reddish brown.....*albiciliata rubricans* Lange
 Primaries brownish gray to whitish.....*albida* (Walsingham)
22. Larger, ranging in size from 20 to 28 mm., with an average of 25 mm.; primaries of grayer tones.....*albidorsella* (Walsingham) [in part]
 Smaller species, ranging in size from 16 to 25 mm.; primaries with brownish tone predominating 23
23. Palpi projecting noticeably beyond frontal tuft, not reaching end of second segment; aedeagus of male genitalia greatly enlarged.....*fragilis* (Walsingham)
 Palpi not noticeably projecting beyond frontal tuft, almost reaching end of second segment; aedeagus of male not enlarged..... 24
24. Primaries grayish brown with outer white line evident through both lobes; legs with distinct darker annuli at the origin of the spurs.....*shastae* (Walsingham)
 Primaries light ochraceous buff, with outer white line not distinct; legs lack the dark annuli*lutescens* Lange
25. Primaries a uniform cinnamon brown with grayish irroration, or with costa slightly darker; spot before cleft absent.....*albiciliata albiciliata* (Walsingham)
 Primaries with a spot or dash before cleft..... 26
26. Costal margin of primaries dark along entire length; a large species, 24 to 31 mm. in wing expanse*xylopsamma* Meyrick
 Costal margin of primaries not dark, or if dark, interrupted by a white dash above cleft 27
27. Primaries a uniform grayish brown, with costal margin lacking a lighter dash directly above base of cleft.....*modesta* (Walsingham)
 Primaries with a lighter dash on costa above base of cleft..... 28
28. Primaries with costal margin mottled, due to patches of lighter scales; size larger, averaging 25 mm.; lobes of primaries wide; uncus of male genitalia tapered to a blunt point distally.....*albidorsella* (Walsingham) [in part]
 Primaries with costal margin not mottled; size smaller, averaging 22 mm.; lobes of primaries narrower; uncus of male genitalia rounded to spatulate..... 29
29. Primaries with two dark scale tufts on inner margin; outer transverse white line through both lobes very evident; uncus of male genitalia not markedly spatulate distally*cooleyi* Fernald
 Primaries lacking scale tufts on inner margin; outer transverse white line not evident; uncus spatulate distally.....*maea* Barnes and Lindsey

TREATMENT OF THE SPECIES

Platyptilia fuscicornis Zeller

(Plate 1, b; plate 2, d; plate 3, d; plate 7, f; plate 13, b; plate 14, i)

- fuscicornis* Zeller, 1877, Hor. Soc. Ent. Ross. p. 460; Walsingham, 1907, Faun. Hawaiiensis, 1:472, pl. X, fig. 4; Meyrick, 1921, The Ent., 54 (no. 703):276 (syn.); McDunnough, 1939, Check List of Lep., part II:37; Lange, 1942, Jour. Econ. Ent. 35(5):722-24, fig. 1(1), fig. 2, A, fig. 3, C, fig. 6, A, B.
- cosmodactylus*, Walsingham, 1880, Pter. Calif. and Ore., pl. II, fig. 4 (misidentification); Meyrick, 1921, The Ent., 54 (no. 703):276.
- marmarodactyla* Dyar, 1902, U. S. Nat. Mus. Bul. No. 52:442; Dyar, 1903, Proc. Ent. Soc. Wash., 5:296 (types designated); Meyrick, 1910, Gen. Insectorum, fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:13; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. of Amer., p. 314-16, pl. XLI, fig. 9, pl. L, fig. 10.
- pasadenensis* Grinnell, 1908, Can. Ent., 40:317 (male); Meyrick, 1913, Wagner's Lep. Cat., pars 17:13; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5868).

Male. General appearance of primaries dark brownish gray with transverse dark line at base of cleft which extends into the usual triangular mark on the costa; this is only faintly outline, a transverse white, wavy line through both lobes; first lobe with a distinct, dark, costal triangle with base on costa, preceded by a brown area with its outer side on the white transverse line. *Head* with palpi in general warm brown, first segment with white scales below and above, second segment with a few white scales below and an expanded tuft of scales above, third segment short, scarcely projecting beyond second; frontal tuft short, subtruncate, dark brown in color; vertex with tuft of scales between antennae, overlapping pedicel; antennae dark brown, dark banded basally, and with white scales basally as seen from below. Thorax brownish gray, tegulae with scales outlined with gray; metathorax above with a black V-mark outlined with white scales. *Primaries* in general dark brownish gray, with costal margin darker and often mottled due to alternate patches of grayish-tipped scales; transverse black line at base of cleft, extending into the usual triangular mark which is only feebly outlined; usual outer transverse white line is wavy, but traverses both lobes; first lobe with a centrally located dark triangular mark with base on costa, preceded by a characteristic brown area, and outlined on its outer face by the transverse white line, the area following the white line whitish or grayish brown; second lobe faintly crossed by transverse white line, rest composed of mixed brown, white and blackish scales; apex not greatly produced; termen undulate; cilia of first lobe with dark bases, outwardly grayish white, interrupted at center and at anal angle by a tuft of white scales; cilia of second lobe as in first, with a white tuft of scales at center giving a divided appearance to the termen; inner margin with dark tuft of scales just inside transverse black line and again three fifths distant from base of wing, with a few scattered black scales; cleft with cilia grayish and scattered black scales, especially at base; tornus prominent, marked with tufts of dark scales; undersurface dark grayish brown, except for costal edge which has white dots basally, a light spot on costa above base of cleft, and a thin transverse white line traversing both lobes. *Secondaries* uni-

form grayish brown; first lobe with bases to cilia on outer margin; third lobe with a subtriangular tuft of black scales at three fifths distant from base of wing, a few black scales at apex, and scattered black scales up to the first scale tuft. *Abdomen* in general grayish brown; first three segments usually with whitish scales, and at the distal margin of the third segment a dark Λ -mark; the rest of the abdomen is dark grayish brown, often with lighter scales at the sides as seen from above; undersurface brownish gray with pale scales at intersegmental junctions.

Expanse. 13–21 mm.

Female. As male, occasionally larger, ranging from 13 to 22 mm.

Male genitalia. Harpes (claspers) blade-like, long, slender; sacculus elongated, set with short spines; costa and valvulus show indication of separation distally on harpe. Uncus slender, set with a few short spines. Anellus lobes inflated apically and apical lobes set with numerous spines; basally continuous with V-shaped basal plate (juxta). Saccus developed, fork-like apically. Tegumen entire, hood-like. Aedeagus greatly developed, long, slender, apically with a few short tubercles.

Female genitalia. Ovipositor lobes narrow, slender. Anterior apophyses long, slender. Posterior apophyses reduced, short. Genital plate broad, grooved at center; Λ -like markings on surface. Ostium opening underneath from center of genital plate. Ductus bursae wide proximally, sclerotized, distally convoluted, leading to sac-like bursa copulatrix. Bursa copulatrix with signa well developed, flattened, with tooth-like projections along edge; measure 0.288 mm. long, 0.108 mm wide.

Types. In the United States National Museum Collection (cotypes).

Material examined. California, 175 specimens; Arizona, 11 specimens; Utah, 4 specimens; Colorado, 1 specimen; Hawaiian Islands, 1 specimen.

California distribution. This species is quite common in the Sonoran and Transition life zones and has been found in the following California counties: Alameda (June, October), Humboldt (June), Lake (June), Los Angeles (March, April, May, June), Marin (May, June, July), Mariposa (July), Mendocino (June, July), Monterey (January, April, May, June, July, August), Napa (March, July, September, October), Plumas (August), Riverside (April), San Bernardino (April, June, July), San Diego (March, April, May, July), San Francisco (May), San Mateo (March, May, September), Siskiyou (July), Tulare (July), Tuolumne (August, September). One specimen was examined in the Los Angeles Museum from Avalon, Santa Catalina Island (May).

Extra-California distribution. In addition to California this species occurs in the United States in Arizona (April, June, July), Colorado (June, July), Nevada (June), New Mexico (May, August) and Utah (June). It is also found in South America and the Hawaiian Islands (Meyrick, 1913).

Biology. This insect is quite widely distributed and is of economic importance to sages, being called in California the sage plume moth. (The old name of "sage worm" is not desirable as other insects cause damage to sage heads.)

The known food plants of the larvae are presented in the tabulation on the following page, together with localities and dates where infestations have been found.

HOST	LOCALITY
<i>Salvia spathacea</i> (Crimson sage, humming-bird sage)	Castroville, Monterey Co., May to October, 1939- 1940 (W. H. Lange).
<i>Salvia mellifera</i> (black sage)	Carmel, Monterey Co., April 4, 1939 (W. H. Lange).
<i>Salvia carnosa</i>	New York Mts., San Bernardino Co., May 15, 1939 (J. A. Comstock).
<i>Salvia</i> sp. (a cultivated blue-flowered sage)	Half Moon Bay, San Mateo Co., June 9, 1940 (W. H. Lange).
<i>Agastache urticifolia</i>	Emigrant Gap, Placer Co., Aug. 10, 1941 (W. H. & P. S. Lange); Yosemite National Park, Big Oak Flat Rd., Aug. 13, 1941 (W. H. & P. S. Lange).
<i>Scrophularia californica</i> (California bee plant)	San Francisco, San Francisco Co., May, 1888 (A. Koebele).
<i>Mentha spicata</i> (spearmint)	Berkeley, Alameda Co., July 13, 1941 (W. H. Lange).
<i>Sphacele calycina</i> (pitcher sage)	Hopland Summit, Lake Co., June 3, 1939 (W. H. Lange).
<i>Pycnanthemum californicum</i> (mountain mint)	Lake Arrowhead, San Bernardino Co., Aug. 16, 1941 (W. H. Lange).
<i>Monardella odoratissima</i>	Foot of Mt. Shasta, Siskiyou Co., July 7, 1941; Ukiah, Mendocino Co., July 4, 1941 (W. H. Lange).

Description of the immature stages. The egg of the sage plume moth is whitish when first laid, later turning to a pale yellowish color. It is elongate-oval in shape, with a truncate end, encircled by a row of tubercle-like processes. The micropylar end is slightly concave. The surface of the egg under magnification is not smooth as the tubercle-like processes extend posteriorly to some extent giving a ridged effect to the egg. Eggs (plate 1, b) range from 0.176 mm. to 0.308 mm. wide and from 0.528 to 0.572 mm. long.

The duration of the egg stage, at Half Moon Bay during June, 1940, at laboratory temperatures, ranged from 7 to 11 days.

The first instar larva is 1.1 mm. long, and the width at the prothorax, 0.176 mm. The color is green, and the body tapers from the head to the posterior end. The head and the dorsum of the cervical shield are brown. Secondary setae are absent, but the body is clothed with moderately long, colorless setae, longer on the prothorax and anal end; the setigerous tubercles being small and dark-spotted. The primary setae are swollen apically. The true legs are slightly darker than the body.

The second instar larva is 2.2 mm. long when extended, and with a width at the prothorax of 0.308 mm. The color is in general a yellow-green, with the head, cervical shield and anal plate dark brown. The body tapers from the center to both ends. The true legs are darker than the body, but the prolegs are concolorous with the underside of the body. Setigerous tubercles are conspicuous, brown, raised, from which extend colorless setae which are slightly swollen apically.

The third instar larva extends to 5 mm. and is of a purplish red color, with a dorsal longitudinal reddish line, and two laterally placed undulating red-

dish lines. The head is black with lighter spots. The true legs are black and the anal proleg darker above, but the prolegs are concolorous with the underside of the body. The primary setae are long, white, and slightly swollen apically. The cervical shield and anal plate are black.

The fourth instar larva is 7-8 mm. long at first, later reaching a length of 11 mm. Several color forms are found, the commonest being purplish red and green, although intermediate color variations are found. All of the varieties exhibit a dorsal longitudinal dark line, two undulatory lateral lines, several inconspicuous lighter lines and prominent white primary setae; secondary setae covering the body are black and white in color and have the apices slightly swollen.

TABLE 1

DURATION OF THE STAGES OF *Platyptilia fuscicornis* ZELLER AT OUTSIDE
TEMPERATURES—HALF MOON BAY—1940*

Eggs hatched	Second instar	Third instar	Fourth instar	Prepupal	Pupated	Adult emerged
Feb. 26.....	Mar. 7	Mar. 19	Mar. 31	April 7	April 9	April 29
Feb. 26.....	Mar. 7	Mar. 19	Mar. 27	April 4	April 7	April 24
Feb. 26.....	.....	Mar. 10	Mar. 19	.....	Mar. 30	April 16
Feb. 26.....	Mar. 4	Mar. 12	Mar. 27	April 7	April 9	April 29
Feb. 26.....	Mar. 3	Mar. 10	Mar. 19	Mar. 31	April 2	April 22
Feb. 24.....	Mar. 3	Mar. 10	Mar. 19	.....	Mar. 30	April 14

* The average number of days involved from hatching of the eggs to emergence of adults was 55.6 days.

The green form has a length of 11 mm. with a width at first thoracic segment of 1.85 mm. The background color is pale green and the head is green, streaked with black. The true legs and anal prolegs are black, and the prolegs are green.

The purplish form is similar to the green variety except that the background is a dull reddish purple.

The pupa is 10 mm. in length, angulate, with conspicuous blade-like processes as in *Platyptilia pica*, and in color is as variable as the larvae, varying from pale green to a deep reddish purple. The pupa is widest at the prothorax, with two separate ridges extending dorsally from the prothorax, reaching a peak on the metathorax and extending posteriorly to the blade-like processes which project from the third abdominal segment. The front is produced and is rounded. Abdominal segments 4-7 inclusive have a pair of anteriorly projecting spine-like processes. In all the color varieties there are indicated two oblique, anteriorly directed dark bands, the posterior one being an extension of the dark blade-like processes. The cremaster is grooved dorsally and has two areas for attachment. In most color varieties there is a dark, subspiracular longitudinal line on the abdomen. The pupa is shown in plate 3, d.

Life history and habits. The complete life history of *P. fuscicornis* at outside temperatures was studied during February, 1940, from adults reared from *Salvia spathacea* at Castroville. The larvae upon hatching were placed on leaves of *Salvia spathacea* in Stender dishes and moist blotting paper was added to maintain the humidity. Changing the food every other day was found to be necessary to keep fungus growth at a minimum. The results of these rearings are presented in table 1.

The life history has been most intensively studied at Castroville on the perennial sage, *Salvia spathacea*, a greatly preferred host of the insect, judging from the populations occurring in this plant. The larvae are more or less external feeders on the small plants, feeding on the terminal shoot with its interfolded leaves; later as the flowering stalk appears the larvae become internal borers inside the flower structures. The larvae feed on several flowers as a rule and when mature go into a prepupal state on the stems or on the outer purplish bracts or undersides of the leaves. The pupa hangs head down, is naked, and is suspended from the posterior end.

The adults mate on the plants, and as in *P. carduidactyla* the male is suspended in the air during copulation. During the day adults can be flushed from the plants, but they are most active at twilight and at night. The eggs are deposited singly (or occasionally two may be glued together) any place on the plants, but are usually placed on the new growth of the flowering stalks, especially on the outer bracts. A count taken of the number of eggs laid to each flower spike on April 28, 1940, showed a range of from 1 to 57 eggs, or an average of 22.05 eggs per spike. On May 7, 1941, a count of the number of eggs laid to a flowering spike showed a range of from 1 to 15 eggs to each spike, with an average of 5.2 eggs laid per spike.

Adults placed in celluloid cages and fed on a 10 per cent sucrose solution at laboratory temperatures (average 69.3° F.) lived from 6 to 52 days.

The seasonal cycle at Castroville on *Salvia spathacea* indicated a life history similar to that of the other members of the genus in California. Four complete broods can occur each year, but the fall generation overwinters so that actually three generations a year are found. The plants of *Salvia spathacea* start producing flower spikes during February and by May the flower heads are in full bloom. At this time and continuing into June the populations of this insect are at a peak. The plants start drying up during July, and so from then into October populations are greatly reduced. Since the plants never dry up completely, the moth is able to carry over until the plants again start growth in the fall.

The only natural enemies observed were an ichneumon, *Posocentrus* sp., a primary larval parasite which was reared in April and May, and a spider predator of the larvae, *Hesperauximus sternitzkii* Gertsch, which was collected April 15, 1940, at Half Moon Bay.

Platyptilia pallidactyla (Haworth)

(Plate 5, a, b, c; plate 13, d, e, f; plate 15, a)

pallidactyla Haworth, 1812 (1803-1828) Lep. Brit., p. 478 (*Alucita*); Tutt, 1906, Brit. Lep., 5:236; Meyrick, 1910, Gen. Insec. fasc. 100: 12; Meyrick, Wagner's Lep. Cat. pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. of N.A., 342-46, pl. XLIV, fig. 3, 4, pl. L, fig. 11; Forbes, 1926, Insects of New York, p. 584 (no. 5881); Pierce and Metcalf, 1938, Genitalia of the Pyrales, Deltoidea, and Plumes, p. 48, pl. XXVI; McDunnough, 1939, Check List of Lep., part II:37 (no. 6476).

adustus Walsingham, 1880, Pter. Calif. and Ore., p. 5-6, pl. 1, fig. 4 (*Platyptilus*).
adusta, Fernald, 1891, Smith's List Lep. N.A., p. 87; Fernald, 1898, Pter. of N.A., p. 32, pl. V, fig. 7, 8; Fernald, 1902 (Dyar's List of Lep.) U. S. Nat. Mus. Bul. 52:443, (no. 4952); Meyrick, 1910, Gen. Insec., fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat. pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5885).

- bertrami* Rössler, 1864, Wien. Ent. Mon., 8:54 (*Platyptilus*); Zeller, 1873, Stett. ent. Zeit., 34:135 (*Platyptilia*); Walsingham, 1880, Pter. Calif. and Ore., p. 3-5, pl. I, fig. 3 (*Platyptilus*); Dimmock, 1882, Psyche, 3:403 (*Platyptilus*); Barrett, 1882, Ent. Mo. Mag., 18:177; Porritt, 1885, Ent. Mo. Mag., 22:103-05 (*Pterophorus*) (biol.); South, 1885, The Ent., 18:279-82; Meyrick, 1895, Handb. Brit. Lep., p. 434; Hofmann, 1895, Deutsch Pter., p. 64, 79 (biol.); Tutt, 1895, Pter. of Brit., p. 31-35; Staudinger and Rebel, 1901, Cat. Lep. Pal. Faun., p. 54 (no. 1329).
- bischoffii* Zeller, 1867, Stett. ent. Zeit., 28:333 (*Platyptilus*); Zeller, 1872, Verh. zööl.-bot. Ges. Wien, 23:317-18 (*Platyptilia*); Murtfelt, 1880, Amer. Ent., 3:235.
- cervinidactylus* Packard, 1873, Ann. Lyc. Nat. Hist. New York, 10:266-7 (*Pterophorus*).
- marginidactylus* Fitch, 1854, New York Agr. Soc. Trans., 14:848 (*Pterophorus*); Fitch, 1856, First Rep. State Ent. New York, p. 144 (*Pterophorus*); Morris, 1860, Cat. Lep. N.A., p. 54 (*Pterophorus*); Walker, 1864, List Lep. Ins. Brit. Mus., 30:940 (*Pterophorus*).
- marginidactyla*, Fernald, 1898, Pter. N.A., p. 34-36, pl. 9, fig. 4, 5; Fernald, 1902 (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:444 (no. 4956); Fernald, 1903, Smith's List N.A. Lep. rev. ed., p. 99 (no. 5345 [4544]); Winn, 1912, List Insec. Quebec, p. 85; Britton, 1920, Ins. Conn., p. 103.
- nebuladactylus* Fitch, 1854, New York Agr. Soc. Trans., 14:849 (*Pterophorus*); Fitch, 1856, First Rep. State Ent. New York, p. 145 (*Pterophorus*); Morris, 1860, Cat. Lep. N.A., p. 54 (*Pterophorus*); Walker, 1864, List Lep. Ins. Brit. Mus., 30:940 (*Pterophorus*).
- ochrodactyla*, Fernald, 1891, Smith's List Lep. N.A., p. 87 (no. 4544) (cited in error).

Male. Color of primaries varies from a creamy white to a dull brown with nebulous darker markings. *Head* with palpi long, slender, slightly longer than frontal tuft with color varying from buff to dark brown; frontal tuft conical, greatly produced, about as long as head. Antennae yellowish white to reddish brown with darker bandings. *Thorax* varies from white to fuscous. *Primaries* vary in the background color from a yellowish white to a dull brown, some uniform in color with little indication of markings; most specimens indicate a dark area in cell, a darker triangular mark, and darker band through both lobes; the usual subterminal lighter line through both lobes is indicated in some specimens, especially on the first lobe; apex produced; first lobe with a pale area above cleft, usually apparent on the costal margin followed by a darker band to the faintly indicated transverse line, then darker to apex; in some specimens the area from the faintly outline triangular mark to the apex is of a light color; second lobe with only faint indications of transverse light line, rest varies according to background of wing; termen of first lobe with darker bases to whitish cilia and a darker tuft at anal angle; termen of second lobe with cilia as in first lobe, in most specimens a darker tuft at anal angle; cleft with white cilia except toward anal angle and anterior angle where the cilia become darker; inner margin with a dark tuft of scales, three fifths from base. *Secondaries* vary from a brownish gray to a dull brown; first lobe with slightly darker bases to cilia on outer margin; second and third lobes with paler bases to cilia; third lobe in some specimens shows a faint tuft of darker scales approximately at center of inner margin. *Legs* almost white with few fuscous scales to almost all fuscous; forelegs with tibia usually darker, especially along inner side, expanded apically; tarsi white to fuscous, slightly darker at apices; middlelegs as forelegs, spur at end of tibia, with short spines; hindlegs with tibia robust, paler proximally, with spur at two thirds from femur-tibia junction and one at end of tibia; length of spines

varies, but usually the spurs have inner spines longer, and the first pair of spurs are longer.

Expanse. 21–26 mm.

Female. As male, except the palpi are slightly shorter.

Male genitalia. Harpes simple, broad, blade-like; sacculus enlarged basally, set with small spines; uncus slender, slightly peaked at apex, with many projecting spines; juxta a triangular basal plate from which arise two broad anellus lobes which have two projections; anellus lobes connect basally; anal tube set with small spines; saccus centrally grooved below; aedeagus short, basally inflated, point of attachment to basal plate, at two-thirds distance from base narrowed toward apical end.

Female genitalia. Ovipositor lobes long, slender; anterior apophyses well developed, inflated at ends; posterior apophyses well developed, slender; genital plate with two lobes with ostium arising on left side, below the left lobe; ductus bursae proximally a heavy sclerotized tube, distally becoming slender; bursa copulatrix sac-like, with signa greatly developed; signa curved, elongated, covered with small tooth-like projections.

Types. The type of *cervinidactylus* Packard, is in the Cambridge Museum. Fitch's types of *marginidactylus* and *nebulaedactylus*, and a paratype of Walsingham's *adusta* are in the United States National Museum. The deposition of the European types is not known to the writer, although the types of *adusta* Walsingham and Haworth's types of *pallidactyla* are probably in the British Museum.

Material examined. California, 17 specimens; Alaska, 1; Arizona, 1; Colorado, 12; Connecticut, 5; Idaho, 12; Massachusetts, 10; New Jersey, 1; Pennsylvania, 14; Utah, 5; Washington, 9; Wyoming, 5; Vermont, 1; Canada: British Columbia, 16; Quebec, 1; England, 2.

California distribution. This species has been found in the following California counties, and with further search will undoubtedly be found to have a much wider distribution: Marin (June), Mendocino (June), Placer (July), Plumas (June), San Bernardino (July), San Mateo (June), San Luis Obispo (June).

Extra-California distribution. This species, according to Barnes and Lindsey (1921) is found over the entire continent of North America north of 37° latitude, from May to August, and is found in England and Europe.

Discussion. This insect shows a great deal of variation in color, length of leg spines, and in size of the genitalia and other morphological parts. At first the writer was inclined to consider the western material as a distinct race (subspecies) because of the darker legs, longer spines of the hind legs and narrow lobes of the primaries. However, the great range in variation which is shown, indicates that until longer-bred series can be obtained, and long series of European specimens examined, it is best to regard the species as it has been considered by Barnes and Lindsey. The coastal California specimens are very dark, with darker legs and long tibial spurs, whereas the palest specimens examined are from Colorado and Wyoming. Specimens from Plumas County, California, and the eastern part of the United States appear more like the two English specimens examined. The latter have larger body and genitalia than any examined from the United States.

Biology. The writer has collected adults flying among *Achillea millefolium* (common yarrow, or milfoil) which is undoubtedly the food plant of the larvae. At Point Reyes on June 7, 1940, three females were collected resting on this plant, and flight was observed to begin at 5:25 p.m. Again at La Honda, San Mateo County, June 9, 1940, two pairs were flushed from yarrow plants, flying short distances from one plant to another. The flight was slow, and they were easily captured. These adults were caged in the laboratory on yarrow, but did not lay eggs. Eggs removed from the ovary of a female were found to be elongate-oval, pale yellow, and with a glossy surface. The eggs ranged in size from 0.264 mm. to 0.308 mm. wide and 0.440 to 0.528 mm. long. The egg is flattened at one end, with an indistinct rosette of tubercles when seen from the side, but not as distinct as in *P. fuscicornis* Zeller. The surface is irregularly corrugated.

The early stages in Europe have been recorded by several workers, where the host plants are *Achillea millefolium*, *A. ptarmica*, and *Tanacetum vulgare*. The larvae feed in the terminal shoots.

Platyptilia carduidactyla (Riley)

(Plate 1, c; plate 4, b; plate 6, a; plate 13, c; plate 15, b; fig. 3.)

carduidactylus Riley, 1869, First Ann. Rep. on the Noxious, Beneficial and other Insects of the State of Mo., p. 180, pl. II (fig. 13, 14), fig. 98 (includes biology) (*Pterophorus*); Riley (1871), *ibid.*, Third Ann. Rep., p. 67-68 (*Pterophorus*); Zeller, 1871, Stett. ent. Zeit., 32:179 (*Platyptilus*); Murtfelt, 1880, Amer. Ent. 3:235 (*Pterophorus*); Dimmock, 1882, Psyche, 3:403, 413 (*Platyptilus*).

cardui Zeller, 1873, Verh. z.b. Ges. Wien, 23:318-19; Walsingham, 1880, Pter. Calif. and Ore., p. 7, pl. 1, fig. 6 (*Platyptilus*); Riley, 1881, Index to Mo. Report, p. 83-4 (*Pterophorus*); Kellicott, 1882, Bul. Buff. Soc. Nat. Sci., 4:47 (biology), (*Platyptilus*); Hy. Edwards, 1889, Bul. U. S. Nat. Mus., 35:136 (*Platyptilus*); Walsingham, 1898, Ent. Mo. Mag., 34:192-3; Walsingham, 1915, Pter. in Biol. Centrali-Americana, 4:438 (distr.).

carduidactyla, Fernald, 1891, Smith's List Lep. North Amer., p. 87 (no. 4547); Fernald, 1898, Pter. North Amer., p. 26, pl. II (fig. 1, 2), pl. 7, (fig. 8-11); Fernald, 1902, (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443; Dyar, 1904, Proc. U. S. Nat. Mus., 27:923; Anderson, 1904, Cat. Brit. Col. Lep., p. 50 (no. 988); Brit. Columbia Ent. Soc. Check List, 1906, p. 42; Meyrick, 1913, Gen. Ins., fasc. 100:11; Winn, 1912, List Ins. Quebec, p. 85; Meyrick, 1913, Wagner's Lep. Cat., pars 17:13; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. of Amer., p. 324-6, pl. XLIII, fig. 1 (key, p. 311-13); Essig, 1922, Calif. Dept. Agr. Mo. Bul., 11 (5-6):454-56; McDunnough, 1927, Roy. Soc. Canada Trans., section v:177, pl. II, fig. 3; Essig, 1929, Ins. of Western N.A., p. 712-13, fig. 591-92; Lange, 1939, South. Calif. Acad. Sci. Bul., 38(1):26-27; McDunnough, 1939, Check List of Lep., part II:37; Lange, 1941, Calif. Agr. Exp. Sta., Bul. 653:1-41, fig. (biol., control); Lange, 1942, Jour. Econ. Ent. 35(5):720-21, fig. 1(4), fig. 2, D, fig. 3, A, fig. 4.

hesperis Grinnell, 1908, Can. Ent., 40:316-17; Meyrick, 1913, Wagner's Lep. Cat., pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. of Amer., p. 325 (syn.).

Male. Primaries vary from buff to brownish buff, with the black triangular mark very distinct; secondaries with a distinct, triangular, black scale tuft at the center of the posterior margin of the third feather. *Head* with palpi brownish buff except for a few white scales on first segment, oblique, surpassing frontal tuft; front tuft moderate, rounded, composed of buff and brown scales; antennae dotted with brown above, especially at base, lighter

underneath. *Thorax* with tegulae composed of buff and brown scales, lighter on metathorax. *Primaries* with background buff to brownish buff, sometimes with purplish tint; usually triangular mark, dark brown, well developed, its outer face outlined by a buff dash which reaches costa, costal margin with mottled appearance due to alternate patches of lighter scales; a darker brown area on basal area of wing reaching inner margin, and often darker above second scale tuft along inner margin; cell with a darker brown dash; apex slightly produced; first lobe uniform dark brown to buff, often with indication of a transverse lighter line and costa sometimes darker; base of whitish cilia darker; second lobe slightly crenulate, as first lobe, with lighter transverse line sometimes indicated very fully; cilia as in first lobe, with dark tuft at anal angle; cleft with cilia brown, with darker scales at outer angles; inner margin with two dark scale tufts, one at three fifths from base, one between this and the anal angle, and dark scales before anal angle; under surfaces with partial transverse buff line through both lobes, a dark spot at usual place of triangle followed by a light patch, the rest of wing a uniform dark brown. *Secondaries* and fringes gray-brown; cilia of first and second lobes with darker bases on outer margin; third lobe with a well-marked, dark brown, triangular mark just before the center of the posterior margin, with scattered dark scales to the base; a few whitish scales before and after triangular mark; and bases of cilia darker on outer, ciliary fringe. *Abdomen* with first two segments buff; often indistinct darker Λ -marks on segments 2 to 4; rest of abdomen brownish buff. *Legs* banded with dark brown, tarsi lighter; forelegs with femur dark brown; tibia buff with darker tuft apically; tarsi light, except last segment, which is fuscous; middle legs as forelegs, except short spines at end of tibia, which are dark tipped; hind legs buff with darker bands on tibia before each pair of spurs and on the distal part of the first tarsal segment; spurs short, stout, inner spine of first pair longer than outer; tarsal segments 2 and 3 white, 4 and 5 darker.

Expanse. 18–30 mm.

Female. As male, except often darker, and with shorter, narrower palpi.

Male genitalia. Harpes simple, elongated, slightly constricted two thirds from base; sacculus inflated at base, extending almost to end of harpe; uncus slightly knobbed apically; juxta crescent-shaped below, extending up to the anellus lobes, which have two peaks; sacculus two-pronged above, grooved below; tegumen divided above; aedeagus inflated basally, then sharply bent at right angles.

Female genitalia. Anterior apophyses slender; posterior apophyses very short; genital plate with two centrally located flaps at the center of which arises the ostium; ductus bursae a long chitinated tube for most of its distance; bursa copulatrix an elongated sac; signa reduced, thorn-like, covered with saw-tooth projections.

Types. The type of *hesperis* Grinnell is in the Los Angeles Museum, and has been examined by the writer and found to be synonymous with *carduidactyla*. (Riley) as was presented in Barnes and Lindsey's monograph.

Material examined. California, 201 specimens; Arizona, 5; Canada: British Columbia, 12; Connecticut, 1; Illinois, 2; Massachusetts, 1; New York, 1; Oregon, 2; Utah, 2; and Wyoming, 4.

California distribution. The known distribution in California by counties, together with months when collections have been made, is presented in the following list: Alameda (September), Del Norte (June), Humboldt (June, July), Lake, Lassen (July), Los Angeles, Marin (March, April, May, June, October, November), Merced (December, January), Mendocino (June, July, August), Modoc, Monterey (February, March, May, June, July, September), Placer (August), Riverside (June, July), San Benito (May), San Bernardino (July, August), San Diego, San Francisco (May, June, July, October), San Luis Obispo (January, April, May), San Mateo (throughout year), Santa Clara, Santa Cruz (February, April, May, September), Shasta (July), Sierra (July), Siskiyou (July), Sonoma (March, April, May, July, October, November), Trinity (June), and Yolo (September).

Extra-California distribution. In addition to California this species has been reported in the following states, every month from April to November inclusive: Arizona, Colorado, Connecticut, Idaho, Illinois, Kansas, Kentucky, Ohio, Oregon, Maryland, Massachusetts, Minnesota, Missouri, Montana, Nevada, New Mexico, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Wisconsin, and Wyoming. In Canada it is found in the provinces of Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. Walsingham (1915) reported it from Guatemala and Costa Rica in Central America.

Biology. Riley (1869, p. 180) described this moth from specimens reared from bull thistle, *Cirsium lanceolatum*, giving in addition a description of the larva and pupa. His biological notes are as follows:

"During the month of May the heads of the above named thistle may frequently be found drawn together by silken threads, with some of the leaves frequently dead. On pulling this webbed mass apart from eight to a dozen thick, smooth worms may be found, which are from a light straw color with rows of black spots, and the head and tail marked. . . . These worms are found in different sizes in the same head, which would indicate that the parent moth either deposits her eggs at different intervals in the same place or that the eggs hatch out irregularly. Towards the end of May they change to pupae within the burrow which the worm inhabited; these pupae being of a dull yellow color, without polish, and resembling the pupae of some long-legged Crane fly (*Tipula*) rather than a moth. In just one week after they have thus changed the moths escape."

In 1922, Essig suggested that the immature stages of the artichoke plume moth in California resembled that of *Platyptilia carduidactyla* (Riley), and presented some preliminary biological notes and control suggestions.

McDunnough (1927) was able to separate satisfactorily this species from *P. percnodactyla* Walsingham, and figured the pupae of both species.

Again in 1929 Essig figured the larvae and pupae and damage to artichokes in California caused by *Platyptilia carduidactyla* (Riley).

The present author first located the immature stages of this moth on *Cirsium edule* and *C. occidentale* at Pescadero, San Mateo County, California, on May 20, 1936. Since this initial discovery it has been found to be a general feeder on members of the thistle genus *Cirsium* and on the globe artichoke, *Cynara scolymus*, and cardoon, *Cynara cardunculus*.

Food plants. The known food plants of the larvae and the localities where infestations have been found are as follows:⁵

HOST	LOCALITY
<i>Cynara scolymus</i> (artichoke)	California; Kansas; Oregon (Specimens in U. S. National Museum, correspondence with Carl Heinrich, August 20, 1938); New Mexico (correspondence with J. R. Eyer, September 30, 1939).
<i>Cynara cardunculus</i> (cardoon or artichoke thistle)	California
<i>Cirsium edule</i> (Indian thistle)	California
<i>Cirsium lanceolatum</i> (common or bull thistle)	California; Oregon; Illinois (Walsingham, 1915); Missouri (Riley, 1869); New York (Kellicott, 1882).
<i>Cirsium occidentale</i>	California (San Mateo County).
<i>Cirsium occidentale</i> var. <i>venustum</i>	California
<i>Cirsium quercetorum</i> (brownie thistle)	California (San Mateo County).
<i>Cirsium discolor</i> (roadside or field thistle)	Minnesota (Marcovitch, 1916).
<i>Cirsium undulatum</i> (wavy-leaved thistle)	Washington (correspondence with R. D. Shenefelt, February 16, 1938).
<i>Cirsium</i> species	New York (Kellicott, 1882); Ohio (correspondence with Annette F. Braun, October 15, 1939); Washington (correspondence with R. D. Shenefelt, February 16, 1939).
<i>Cirsium arvense</i> (Canada thistle)	California (Maple Creek, Humboldt Co., June 21, 1940).
<i>Cirsium americanum</i> var. <i>callilepsis</i>	California (Lucas Canyon, Marin Co., May 17, 1940).
<i>Centaurea melitensis</i> (Napa thistle)	California (Pismo Beach, San Luis Obispo Co., Jan. 10, 1938).
<i>Silybum marianum</i> (milk thistle)	California (Essig, 1922).

The most highly preferred food plant in the coastal areas of California is the Indian thistle, *Cirsium edule*, which grows throughout the year on north hillsides or along creeks, allowing the moth to carry over from one generation to the next one. *Cirsium lanceolatum*, or bull thistle, grows in drier localities and often serves as a summer host in areas where *Cirsium edule* dries up during late summer. The tomentose thistle, *Cirsium occidentale*, is selected in the coastal areas of California where the larvae tunnel inside the succulent stems or into the flower heads (fig. 3).

Since the list of food plants was given by Lange (1941), two additional hosts—Canada thistle, *Cirsium arvense*, and a variety of *Cirsium americanum*—have been found to serve as food plants. The one infestation of *Centaurea melitensis* at Pismo Beach is interesting in that this infestation was apparently from infested artichokes near by.

⁵ California records without name reference are those obtained by the author. Names in parentheses with year citations indicate references in "Selected Bibliography."

Description of the immature stages. The egg is oblong-elliptical to oval, smooth and glossy, and is a pale yellowish color. In size, eggs range from 0.52 to 0.66 mm. long and from 0.26 to 0.35 mm. wide. Before emergence the eggs turn darker and the darker head of the larva can be seen through the egg covering. The eggs can be laid on a horizontal or vertical axis in relation to the leaf surface on any part of the plants, but they are usually laid on the woolly heads of the hosts or on the undersides of the leaves among the woolly hairs.

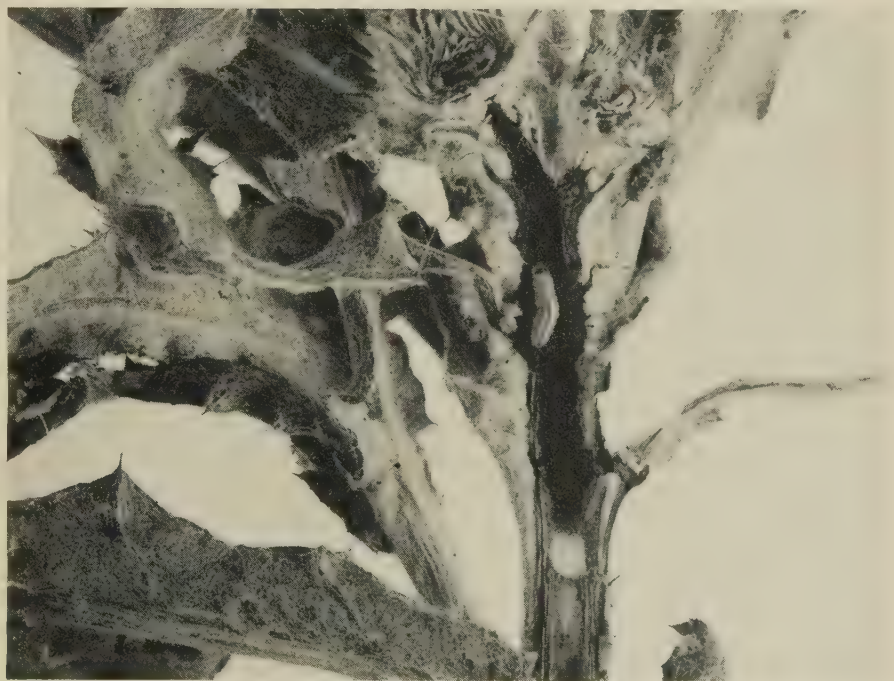


Fig. 3. Mature larva of *Platyptilia carduidactyla* (Riley), boring in stem of *Cirsium occidentale* at Pescadero, Monterey County, California, June 19, 1936 ($\times 2$). Stem is split longitudinally to show larva.

The larva during its development molts three times and therefore passes through four instars. Head capsule measurements have verified rearing records in regard to the presence of four instars. A description of the different larval stages is presented as follows:

First instar larva is approximately 1 mm. long. Color, pale yellowish, with cervical shield and anal plate brown. Four pairs of prolegs, one each on segments 6, 7, 8, and 9, and an anal pair; stalk-like, concolorous with underside of body. Primary setae moderately long, colorless, arise from minute, black-spotted tubercles. Head black; large in proportion to rest of body.

Larvae in the first instar feed chiefly among the tender interfolded leaves of the hosts, but can bore directly into flower structures or into the stems or leaf stalks.

Second instar larva is approximately 3 mm. long. Color, as in first instar with the darker head, cervical shield, anal plate, and true legs.

Second instar larvae may feed externally, but are for the most part internal borers in the stem, leaf-stalks, or flower parts.

Third instar larva is 5 mm. long. Markings as in the second instar larva.

Third instar larvae are chiefly internal borers, but as in the previous instar they can feed externally.

Fourth instar larva is 7 mm. long at molting; at maturity 12 mm. long. Color for the first five days a grayish white, then turning to yellowish or pinkish yellow; head, cervical plate, true legs, and anal plate black. Body covered with characteristic short, black secondary setae. Prolegs distinctly stalk-like. Primary setae arise from darker tubercles.

Fourth instar larvae are for the most part internal borers in the stems, leaf-stalks, or flower structures of the host plants.

The prepupal larva is essentially the same as the fourth instar larva. The body becomes greatly swollen and all feeding ceases.

Pupa is 10 to 12 mm. long, slightly angulate. Color varying from a light yellowish brown to dark brown; abdomen often with a dorsal longitudinal dark brown line, and similar subdorsal and subspiracular lines. Abdominal segments with distinct tooth-like spines which project posteriorly. Front produced downwardly in beak-like fashion. Attached nakedly by the cremasteric end by two areas of attachment.

Life history and habits. In the central coastal areas of California *Platyptilia carduidactyla* has three overlapping generations a year so that all stages can be found during every month. The life history is chiefly above the ground although occasionally larvae may bore for short distances into the crowns of thistles during the fall of the year. The insect is not adapted to prolonged hibernation or aestivation in California and so it must have an adequate supply of available hosts for egg deposition. The adults are chiefly nocturnal, although activity may start during the twilight hours. Eggs are deposited singly and externally among the hairs on the undersides of the leaves, on the flower structures, or occasionally on other portions of the plants. The larvae are active, feeding chiefly externally during the first two instars and internally as borers during the later larval stages. The larvae may leave the heads and seek out places for pupation. Pupation usually occurs in the larval burrows, but may occur any place on the plant.

The adults are less often encountered than the larvae as they are chiefly crepuscular and nocturnal, resting during the day on the plants. They can be flushed, however, from the foliage, flying for short distances where they rest on near-by plants. The moths are nervous, having a peculiar habit of fitting the wings up and down.

Mating usually occurs within three days after emergence and can take place without previous feeding. The mating process is interesting in that the male is usually suspended from the female in mid-air. The process can also occur on a horizontal substratum with the male and female opposite one another, as is the case in many other moths.

The flight habits of the adult and its reactions to light are presented in the article by Lange (1941) and need not be emphasized here. The minimum

flight temperature was found to be 46° F although most flight ceased at 50° F. Temperature seemed to be one of the chief factors in determining flight, as adults were observed flying from dusk to midnight. Moths have been observed to fly to considerable heights into the air when aided by wind currents; in fact, during the summer of 1938, adults were followed in the air until they were lost to sight.

The larvae upon hatching usually migrate to the base of the plants to seek out the tender interfolded leaves of the plants, but may crawl into an artichoke or thistle head, or can bore directly into the stems. Inasmuch as the eggs are usually laid on the under sides of the leaves, the young larvae have to migrate in order to find suitable food and refuge. The larvae bore into the flower heads, stems, or petioles, and may often migrate from one flower head to another or seek out another stem. When mature, the larva may pupate in the burrow in a position where the adult can emerge, or, in the case of artichoke heads, pupate on the outer bracts.

Duration of the immature stages. Adults lay from 70 to 300 eggs, with an average of 170. The duration of the egg stage ranges from 10 to 24 days depending upon the temperature. The duration of the stages both at laboratory and outside temperatures is presented in the article by Lange (1941). At laboratory temperatures the length of time elapsing from the hatching of the egg to emergence of adults was 63.16 days at an average mean temperature of 62.68° F. The same period at outside temperatures with a mean average temperature of 56.16° F was 96.42 days.

The average life for the adults is 30 days when fed on sucrose solution, although at laboratory temperature adults live approximately from 14 to 18 days. No food is needed to secure egg deposition, but more eggs are laid if food is supplied. The larval period varied from 34 to 54 days at laboratory temperatures, whereas this period at outside temperatures varied from 32 to 86 days. The pupal period varied from 10 to 30 days in the field, whereas under laboratory temperatures a range of from 22 to 28 days has been recorded. A preovipositional period of 3 to 8 days has been found.

Seasonal cycle. The seasonal cycle of the artichoke plume moth has been presented in the article by Lange (1941). It has two interesting features: first, the fact that all stages can be found during every month of the year, and second, the fact that although the cycle from larva to egg can occur four times each year, the cycle is best represented as containing three overlapping generations. The summer generation on artichoke is the only cycle which is readily separated, and the larvae complete their cycle chiefly as borers in the petioles since very few floral heads are produced at this time. The fall generation starts in September. Some adults emerge in November, laying eggs to start a generation which is continued into the spring and is designated the spring generation. All stages of the fall generation carry over the winter, with adults of this generation emerging into March.

The cycle on thistles in California is similar to that on artichoke as a succession of thistle hosts allows the moth to carry over the dry fall months. The centralized nature of growth of thistles, as contrasted with the open growth of artichokes, allows a greater concentration of larvae at the center of the plants than is found on artichokes.

Natural enemies. The larvae of the artichoke plume moth have a number of hymenopterous and dipterous parasites. The most effective are in the family Ichneumonidae. The parasites of the larvae are tabulated below, together with their role.

LARVAL PARASITES

Angitia platyptiliae Cushman
Gelus sp.
Dibrachys cavus (Walker)
Epiurus bicoloripes Ashmead
Phaeogenes sp.
Pachyneuron allograptae Ashmead
Colpognathus helvus (Cresson)
Microbracon nevadensis (Ashmead)
Hyalomyodes triangulifera Loew
Lispidea spp. (two species)
Plectops sp.

ROLE

primary on larvae
 secondary through *Angitia platyptiliae*
 secondary through *Angitia platyptiliae*
 primary on larvae
 primary on larvae, emerging through pupae
 secondary through *Phaeogenes* sp.
 primary on larvae
 primary on larvae?
 primary on larvae
 primary on larvae
 primary on larvae

The most effective larval parasite is an ichneumon, *Angitia platyptiliae* Cushman (1939) which parasitizes from 2 to 90 per cent of plume moth larvae, with an average of around 10 per cent. It is a black species with reddish legs, from 5 to 7 mm. in length, with antennae about 4.5 mm. long. In the female the ovipositor sheath is 2 mm. long. The adult females seek out the larval burrows, inserting the eggs in half-grown larvae. The plume moth larva is consumed in a few days, and the parasite spins a brown cocoon. The ichneumon, *Epiurus bicoloripes* Ashmead, is an effective parasite on this-tles. *Phaeogenes* sp. parasitizes the larvae with the adults emerging through the pupae.

Predators of the larvae include several undetermined staphylinid larvae, and several spiders, including *Herpyllus* sp. (possibly *H. hesperolus* Chamberlin). The cliff swallow has been observed feeding on adults during the summer of 1938. The large reddish mite, *Anystis agilis* Banks often preys upon newly laid eggs.

Platyptilia percnodactyla (Walsingham)

(Plate 1, a; plate 5, e; plate 13, h; plate 15, c)

percnodactylus Walsingham, 1880, Pter. Cal. and Ore., p. 8-10, pl. I, fig. 7 (*Platyptilus*).
percnodactyla, Fernald, 1891, Smith's list of Lep. No. Amer., p. 87 (no. 4549); Fernald, 1898, Pter. No. Amer., p. 27-28, pl. VIII, fig. 14, 15; Fernald, 1902 (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443; Anderson, 1904, Cat. Brit. Col. Lepid., p. 50 (no. 989); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Meyrick, 1910, Gen. Insec., fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:14; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. of Amer., p. 326-27, pl. XLIII, fig. 2, pl. L, fig. 14; McDunnough, 1927, Trans. Roy. Soc. Canada, section V:177, pl. II, fig. 2 (host, fig. pupa); McDunnough, 1939, Check List of Lep., part II:37.

Male. Similar to *carduidactyla*, but with lobes of primaries broader, and with the area beyond the transverse white line more distinct, the triangular mark on the third feather of secondaries more reduced, the palpi noticeably longer, and the male and female genitalia with noticeable differences. **Head** with palpi long, slender, slightly ascending, buff-brown with a few whitish scales on first segment and at apex of third; frontal tuft conical, longer than in *carduidactyla*, but not surpassing palpi; color, buff to buff-brown; antennae

with alternate dark and white spots, lighter basally on underside. *Thorax* buff to brown-buff; lighter on metathorax. *Primaries* grayish buff to brownish buff; usual triangular mark dark brown, well-marked; light transverse line usually reduced, especially on second lobe; costa darker; first lobe with lighter area beyond triangle, a dark area beyond white subterminal line, often with a dark dash just before subterminal line, anal area beyond subterminal line usually a darker buff-brown; second lobe well developed, with subterminal line faintly indicated and area beyond line a darker buff-brown; fringe of both lobes grayish white with dark bases; cleft with fringe white except at outer angles; a dark tuft at anal angle of second lobe; inner margin with two dark tufts, one below start of triangle, another below cleft, and darker scales preceding anal angle. *Secondaries* a uniform, dark grayish brown, with fringes appearing slightly lighter; bases of fringes on first and second lobes darker; a scale tuft on posterior margin of third lobe composed of scales of approximately the same length located just before center of lobe, and a few scattered darker scales to base of wing. *Abdomen* buff-brown, often paler at first two segments. *Legs* buff with dark buff-brown bands; forelegs buff-brown with a few white scales, and a dark tuft at the distal end of tibiae; middle legs dark buff-brown except for the basal half of the first tarsal segment which is white; a dark tuft distally on tibiae and with a pair of stout spurs; hind legs stout, buff with a brown band before each pair of spurs; an enlarged tuft of scales at distal end of tibiae; tarsal segments with distal half of first segment dark brown and the last two tarsal segments dark fuscous, the rest white.

Expanse. 20–24 mm.

Female. As male, except often larger, reaching an expanse of 29 mm.; the darker markings are usually more pronounced, often showing a dark dash at the center of the first lobe of primaries; the palpi are longer.

Male genitalia. Harpes simple, broad, blade-like; slightly constricted on outer edge at about two thirds from base; uncus knobbed apically; anellus lobes with two points, the first pair short, stout, bluntly pointed, the second pair slender; saccus broad, with two divergent arms above, and with a central notch below; tegumen appears divided above; aedeagus enormously developed, inflated basally, then directed at right angles into a long, slender tube.

Female genitalia. Ovipositor lobes broad, set with numerous long spines; anterior apophyses long, stout, sometimes with a nodule-like inflation near ends; posterior apophyses short, outwardly curved; genital plate with two flap-like structures medially, between which arises the ostium; the ostium is wide and leads into the well-sclerotized ductus bursae which is stouter but not as long as in *carduidactyla*; ductus bursae slightly inflated at ostium, then narrowing, practically sclerotized all the way to the bursa; bursa copulatrix an elongated sac, with the signa well developed, much longer than in *carduidactyla*; signa stout, curved, and covered with short projecting tubercles.

Types. In the British Museum. Two cotypes in the collection of the United States National Museum have been studied by the writer.

Material examined. California, 53 specimens (including 2 of Walsingham's cotypes); British Columbia, 5 specimens; Idaho, 1; New Mexico, 1; Washington, 2; and Wyoming, 2.

California distribution. In California this species occurs in mountain meadows in the Boreal life zone. The writer found it very numerous at Crescent Meadow in Sequoia National Park (Tulare County) on August 21 and 22, 1941, where it was depositing eggs on *Helenium bigelovii*. Other California records include the following: Glen Alpine, Lake Tahoe (Eldorado County), July 8–15, Glen Alpine Creek (Eldorado County), July 15, 1909. (F. X. Williams), Mineral King (Tulare County), July 8–15. Records sent from the United States National Museum also include the following which the writer has not been able to verify: Carmel (Monterey County), June; Claremont (Los Angeles County), no date; and Sonoma County, May. Walsingham took his types at Hatchet Creek, Shasta County on July 14, 1871. The writer was not able to collect this species at its type locality during an attempt in July, 1941.

Extra-California distribution. In addition to California it has a wide distribution. Lindsey (1931) lists it as occurring from British Columbia to Alberta, south to Wyoming, Utah, and southern California. The data concerning the specimens examined by the writer is as follows: British Columbia (June, July, August, October); Godman Springs, Blue Mountains, Washington, July 14, 1935 (on *Rudbeckia*, J. F. G. Clarke); and Mt. Rainier, Washington, July 13, 1939 (E. C. Johnston); Moran, Wyoming, July 20, 1938 (C. H. and J. L. Sperry); Moose P.O., el. 6,700 ft., Wyoming (A. B. Klots); Wallace, Idaho, July 1–7 (Sweadner); and Mt. Jefferson, White Mountains, New Mexico, August 20, 1936 (G. H. and J. L. Sperry). McDunnough (1937) took it at Waterton Lakes, Alberta, Canada, during June, 1923.

Discussion. I place the specimen from Idaho as this species (*percnodactyla*) with some hesitation because of its darker color; however, the female genitalia of the single specimen seem very close. Considerable variation in the female genitalia is noticed; the terminal inflations of the anterior apophyses are gone in some, and there is great variation in the length of the posterior apophyses. A slide made of the "type" of Walsingham very definitely indicates the status of this species. The long aedeagus will separate it from any other of our known species.

Biology. The writer was able to make observations of this species on August 21 and 22, 1941, at Sequoia National Park, Tulare County, California. It was abundant in high montane meadows at elevations of from 8,000 to 9,000 feet. Adults were collected on August 22 and placed in battery jars at Berkeley with the result that one female deposited about 36 eggs on the heads of *Helenium bigelovii* (Bigelow sneezeweed), which was selected for oviposition by the moths in the field. In Crescent Meadow adults seemed to be associated with another plant, *Senecio covillei*, but this plant was not actually proved a host, inasmuch as it was also selected for oviposition by two species of *Oidaematophorus* and these eggs were confused at first with those of *percnodactyla*. No larvae or pupae were found, and the writer was unable to rear the larvae past the first instar. The description of the egg and first instar larva follows:

Immature stages. The egg is a pale yellow color, glossy, and in size is 0.572 mm. long and from 0.352 to 0.396 mm. wide, and elongate-oval to egg-shaped in outline. Eggs are laid singly, or often two or three are glued together, on

the undersides of the outer floral bracts, or among the individual flowers of the composite head. The eggs can be laid flat or on end as is true for *carduidactyla*.

The first instar larva is 1.67 mm. long, the head 0.53 mm. wide, and the color a pale yellowish. The head, cervical shield and anal plate are light brown, and the three pairs of true legs are darker than the body. The prolegs are stalk-like, concolorous with the underside of the body, and the primary setae are colorless.

J. F. Gates Clarke sent a female from Godman Springs, Blue Mountains, Washington, reared from *Rudbeckia* sp. on July 14, 1933. The description of the pupa is from the pupal case of this specimen.

The pupa is 13 mm. long, robust and of the same general shape as the pupa of *carduidactyla*. However, spine-like processes of the abdomen, which are so prominent in *carduidactyla*, are absent. The head has the front produced into a beak (with a dorsal ridge and two lateral ridges) which is curved slightly downward.

On the dorsum of the flattened mesothorax are two reduced ridges which converge posteriorly and do not go beyond the metathorax. The pupa is brown (judging from this cast pupal case), the abdomen showing a feeble intermittent dorsal longitudinal line and two subdorsal darker lines, while subventrally there is a wide, dark, longitudinal line followed beneath by a double row of wide blotches on each segment. The cremaster has two ridges and a central concavity dorsally, is not greatly produced, and has two areas of hooked setae for attachment. The wing cases are dark brown with a central lighter area, and the appendages are dark brown with a light spot at the center of each of the middle legs.

Adults. Adults were found more active during the late afternoon and early evening than at night when temperatures were low and the vegetation wet with dew. On the night of August 21, a pair was found mating on an *Helenium* plant at 9:30 p.m., the male being suspended in the air from the female. On August 22, another pair was found mating at 4:14 p.m., and in this instance the male was above the female, both resting on the plant. The flight of the adults was not strong. Usually they flew only from 10 to 15 feet and then came to rest on another plant.

Of the twelve adults brought back to Berkeley, only one female and several males survived. The female was observed mating on August 23 at 1:15 a.m., but not at 8 a.m. Eggs were laid on the glass jar as well as on the foliage in the jar. McDunnough (1927) at Waterton Lakes, Alberta, Canada, found the food plant of *pernodactyla* to be *Erigeron speciosus* and figured the pupa of this species.

Platyptilia williamsii Grinnell

(Plate 1, d; plate 6, b; plate 13, g; plate 14, j; fig. 4; fig. 5)

williamsii Grinnell, 1908, Can. Ent., 40 (9):315-16; Meyrick, 1913, Wagner's Lep. Cat., pars 17:14; Barnes and Lindsey, 1921, Pter. of Amer., p. 330-31, pl. XLI, fig. 14; McDunnough, 1939, Check List of Lep., part II:37; Lange, 1939, South. Calif. Acad. Sci. Bul., 38(1):26-7 (hosts); Lange, 1942, Jour. Econ. Ent., 35(5):722, fig. 1 (5), fig. 2, E, fig. 3, D.

williamsi, Barnes and McDunnough, 1971, Check List of Lep., p. 150 (no. 5876).

Male. Color very variable, but background ranging from a ferruginous brown to a brownish gray; the triangular mark usually feebly indicated and first lobe of primaries with the subterminal lighter line indicated; scale tuft on third lobe of secondaries at center, composed of a few scales of approximately equal length, only feebly indicated. *Head* with palpi moderately long, brown in color with a few light scales on first segment above and the third segment tipped with white; second segment with an expanded group of scales above; noticeably surpassing frontal tuft; frontal tuft moderately rough-scaled, with a few white scales among the brown; slightly rounded, not abruptly truncate; antennae brown; sometimes spotted with lighter scales. *Thorax* brown with mixed grayish-white scales, usually with lighter scales behind. *Primaries* with background ranging from a ferruginous brown to a brownish gray; triangular mark absent to evident, usually only feebly indicated; costa usually darker brown; usually a dark spot in cell; first lobe unicolorous or with a dark band based to subterminal line; second lobe unicolorous, sometimes subterminal line feebly indicated; apex moderately produced; whitish fringe with dark bases and tipped with grayish; cleft with fringe of mixed brown, white, and grayish scales; termen of second lobe rounded, or sometimes slightly peaked at center; inner margin with variable dark scaling, but usually one group of scales at two thirds from base, continued as dark scales to beyond triangle, and scattered black scales basally. *Secondaries* uniform grayish brown with fringes appearing slightly lighter; first lobe with bases of fringes darker on outer margin; second lobe with a few darker scales to base of fringe at anal angle; third lobe with a few dark scales at about center of lobe, with scattered dark scales to base of wing, and often with dark scales from base to apex of lobe. *Abdomen* in general grayish brown; paler at first two segments, rest of scattered white, gray, and brown scales; in some specimens indistinct dark Λ -markings on segments 3 to 5. *Legs* suffused, with banded hind tibiae; forelegs with femora long, brown; tibiae with expanded tuft of dark brown scales; tarsi white and fuscous; middle legs with long tibiae, with two apical spines; hind legs with tibiae brown, with darker bands before the spurs; first pair of spurs with inner spine noticeably longer; second pair of spurs short, thick, inner spines only slightly longer than outer; tarsal segments dark banded on apical portions of segments.

Expanse. 16–24 mm.

Female. The markings of the females are usually more contrasty than those of the males, and of a more intense grayish tone; the triangular mark is more distinct on the primaries, followed by a lighter area on the first lobe, then a distinct subtriangular dark blotch, with base on costa, just before subterminal line. Some specimens show a darker line near inner margin on basal area of wing, and a dark streak in the cell.

Male genitalia. Harpes simple, blade-like, constricted slightly on outer edge at two thirds from base; sacculus inflated basally, extending almost to apex; uncus slightly knobbed apically, set with spines below; anellus lobes with two peaks, set with small spines; saccus with two small projections above, grooved below about half of depth; tegumen with groove above; aedeagus short, inflated basally, curved at an obtuse angle.

Female genitalia. Ovipositor lobes broad, set with numerous spines; anterior apophyses well developed; posterior apophyses short; genital plate with two centrally located flaps (as in *carduidactyla*) between which arises the ostium; ductus bursae well developed basally, but not as long as in *carduidactyla*, distally becoming a slender tube; bursa copulatrix an elongated sac with the signa thorn-like, moderately developed, with their surface covered with tubercle-like projections.

Types. The deposition of the type is not definitely known by the writer. Certain of Grinnell's types in the collection of the Southwest Museum at Los Angeles, California, and later moved to the Los Angeles Museum, were destroyed by dermestids. The type was not found in 1938 when the writer examined the collection at the latter institution.

Material examined. California, 164 specimens.

California distribution. This is a rather common species in California, and when the full distribution is known it will probably be a great deal more extensive than the presently known records indicate, which are compiled by counties as follows: Alameda (February, March, July, September, December); Marin (February, March, June); Mendocino (June, August, September, October); Monterey (February, May, June, July); Los Angeles (June); San Diego (June); San Francisco (March, May, June, July, September, October, November); San Luis Obispo (May); San Mateo (every month); Santa Barbara (May); and Sonoma (April, May, June, September, October). It also occurs on Santa Catalina Island (April 24, 1932, Don Meadows).

Extra-California distribution. The writer has seen typical specimens only from California. The specimens called *williamsii* by McDunnough (1927) do not agree in all details with California specimens, having shorter palpi and differently shaped wings. The male genitalia are very close to *williamsii* Grinnell. *P. comstocki* Lange, also has male genitalia close to typical *williamsii* and the Canadian material, but can be differentiated, with careful study, by the shape of the wings, and differences in the male genitalia. The palpi of *comstocki* do not project noticeably beyond the frontal tuft, as in typical *williamsii*.

Biology. A few of the main features of the biology of this insect were presented in the article by Lange (1941). The known food plants of the larvae are presented in the following tabulation together with the counties where infestations have been found:

HOST	LOCALITY
<i>Erigeron glaucus</i> (seaside daisy)	Coastal Monterey County to Oregon
<i>Calendula</i> spp. (<i>Calendula</i> or pot marigold)	Central and southern California
<i>Grindelia robusta</i> (gum plant)	Central California
<i>Achillea millefolium</i> (common yarrow)	Central California
<i>Chrysanthemum</i> spp. (chrysanthemum)	Central California
<i>Eriophyllum staechadifolium</i> (lizard tail)	Coastal Monterey County to Del Norte County

HOST	LOCALITY
<i>Cynara scolymus</i> (artichoke)	San Mateo and Santa Cruz counties
<i>Tanacetum camphoratum</i> (dune tansy)	Central California
<i>Layia hieracioides</i>	San Mateo County
<i>Hemizonia corymbosa</i>	San Mateo County
<i>Artemisia vulgaris</i> (wormwood)	San Mateo County
<i>Gnaphalium decurrens</i> (California everlasting)	Central California
<i>Aster</i> sp. (michaelmas daisy)	Central California
<i>Madia sativa</i> (chile tarweed)	San Mateo County
<i>Franseria bipinnatifida</i>	Los Angeles County
<i>Senecio aronicoides</i> (?)	Monterey County
<i>Senecio blochmanae</i> (?)	San Luis Obispo County
<i>Anaphalis margaritacea</i>	Mendocino and Monterey counties

Description of immature stages. The egg is oblong-ovate, glossy, with a width of from 0.22 to 0.31 mm. and length of from 0.44 to 0.53 mm., and is of a pale yellowish color. Eggs are laid on end or on the side as in several other species in the genus.

Four larval instars are found. The first instar is 1 mm. long, of a pale yellowish color with a dark brown head and lighter brown cervical shield and anal plate. The setae are moderately long and arise from brown setigerous tubercles. The true legs are brown, but the stalk-like prolegs are concolorous with the body. The body tapers toward both ends.

The second instar larva is 2 mm. long, and is essentially the same as the first instar larva. Under magnification, secondary setae appear as small dark points, and the spiracles are dark ringed.

The third instar larva is 4 mm. in length (following the molt), of a grayish-yellow color, with the head, cervical shield and anal plate brown. The other features are essentially the same as in the previous instars.

The fourth instar larva attains a length of from 8 to 10 mm., is a dirty yellowish in color, with longitudinal reddish lines: a dorsal line, a subdorsal interrupted line, and a rather indefinite spiracular line. The true legs are black, but the prolegs are the same color as the body. The cervical shield is yellowish, outlined with black, and the anal plate is dark only at the center. The crochets are arranged in a half circle, and contain 9 crochets on the regular prolegs and 11 on the anal proleg. Under magnification the body is covered with small sharp-pointed spines, and verrucae occur on the thoracic segments and one containing two setae, in the prespiracular position. The setae are not inflated at the ends as in certain other plume moths.

The pupa is from 7 to 9 mm., at first a greenish color, but later the color changes to various shades of brown. The front is directed more anteriorly than in *carduidactyla* and, in addition to this feature, the spines of the abdomen are lacking.

Life history and habits. The larvae of this species are general feeders on composites as can be seen by reference to the long list of host plants. Its serious damage to calendula suggested the name "calendula plume moth" which the writer suggested in a recent article (Lange, 1941). A readily selected host is the perennial, *Erigeron glaucus*, which occurs along the coast of California and allows this moth to feed throughout the year (fig. 4). Most of the food



Fig. 4. A preferred food plant of *Platyptilia williamsii* Grinnell, *Erigeron glaucus*, showing a mature larva feeding on the terminal shoot. Half Moon Bay, California, March 15, 1947.

plants are perennials, thus allowing this moth to maintain populations on most of these plants.

The adults are rather weak fliers and fly chiefly at night, although they can be flushed from the food plants during the day. Caged adults have laid up to 105 eggs. The adults lay the eggs on any part of the plants, but usually select the flower structures, stems, or the undersides of the leaves. The larvae, upon hatching, seek out the flower parts if they are present, start boring inside the terminal shoots or stems, or can feed more or less externally among the tender leaves of the terminal shoots. Upon completing their development the larvae pupate in the lower parts, stems, or can crawl out and pupate any place on the plants. Usually the pupa is naked, but a slight cocoon can be found in exposed locations.

The duration of the time elapsing from hatching of the eggs to emergence of adults during 1937 at laboratory temperatures ranged from 34 to 48 days. The larval stage varied from 10 to 34 days, and the pupal stage 8 to 12 days. The egg period varies from 7 to 10 days at laboratory temperatures.

Seasonal cycle. The seasonal cycle on calendula during 1938 at Half Moon Bay in outside cages is presented in figure 5. The cycle presented here is very similar to that of the artichoke plume moth. Four broods a year can occur, but the fall generation overwinters and is not completed during the year.

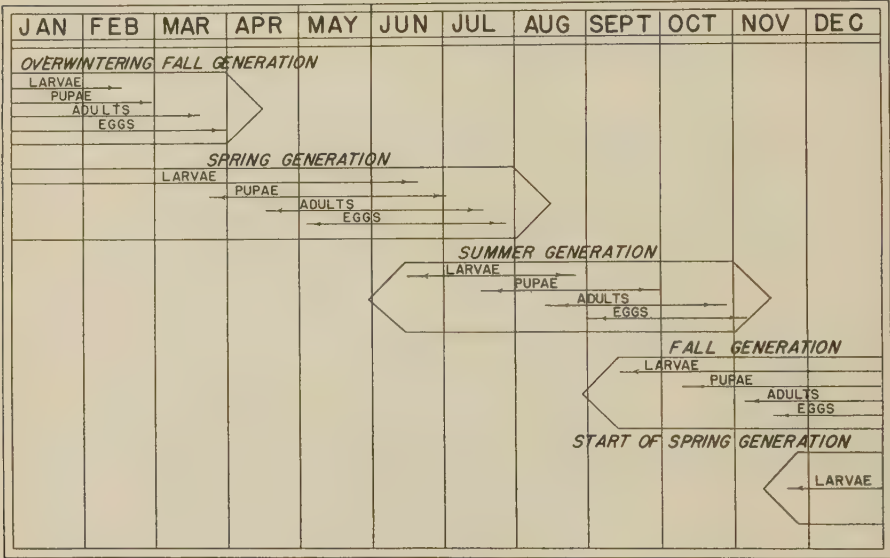


Fig. 5. The seasonal cycle of *Platyptilia williamsii* Grinnell on *Calendula* sp. at Half Moon Bay, California, 1938. (The duration of the different stages is the total period during which a stage was found, and not the duration of an average individual.)

During 1936 and 1937 on *Erigeron glaucus*, at Half Moon Bay there was evidence of two complete summer generations which, in this case, would make four instead of three generations a year.

Natural enemies. The ichneumons, *Angitia* sp., *Campoplex* sp., and *Epiurus bicoloripes* Ashmead, are natural enemies of the larvae. The first mentioned is often an effective parasite, but its effect is reduced by a secondary species, *Hemiteles* sp.

Platyptilia taprobanes (Felder)

(Plate 7, c; plate 13, i)

taprobanes Felder, 1875, Reise Novara, Lep. Het., pl. 140, fig. 54 (*Amblyptilia*); Moore, 1887, Lep. Ceylon, 3:527 (*Amblyptilia*); Cotes and Swinhoe, 1889, Cat. Moths India, p. 668 (No. 4540) (*Amblyptilia*); Meyrick, 1913, Wagner's Lep. Cat., pars 17:10; Fletcher, 1932, Life histories of Indian Microlepidoptera (second series), Govt. of India, Calcutta, Mon. No. 2:5-6, pl. III (syn., biology); Lange, 1939, South. Calif. Acad. Sci. Bul., 38:159-60, pl. 35 (syn.).
acanthodactyla var. *phoenicodactyla* Chrétien, 1915, Ann. S.E. France, 84:295 (distinct sp?).

- brachymorpha* Meyrick, 1888, Ent. Soc. of London Trans., p. 240-241; Meyrick, 1906, Bombay Nat. Hist. Soc. Jour., 17:135; Walsingham, 1907, Faun. Hawaiiensis, I:474 pl. X, fig. 5; Meyrick, 1907, Ent. Soc. London Trans., p. 483; Fletcher, 1909, Spolia Zeylandica, 6(21):12, pl. A, fig. 3 (dist., Ceylon); Maxwell-Lefroy, 1909, Indian Insect Life, p. 528; Meyrick, 1910, Gen. Insec., fasc. 100:10; Fletcher, 1910, Linn. Soc. Trans. (Zool. ii), 13:401; Meyrick, 1913, Wagner's Lepid. Cat., pars 17:11 (syn., dist.); Fletcher, 1921, Indian Agr. Ent. Mem., 6:21, pl. 3, fig. 2; pl. 6 (fig. pupa); Meyrick, 1921, The Ent., 54:275 (no. 703) (syn.); Meyrick, 1922, Ark. Zool., 14 (no. 15): 1.
- crenulata* Barnes and McDunnough, 1913, Cont. Nat. Hist. Lep. N.A., 2:185, pl. III, fig. 8; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Grossbeck, 1917, Amer. Mus. Nat. Hist. Bul., 37:135; Barnes and Lindsey, 1921, Pter. of Amer., in Cont. Nat. Hist. Lep. N.A., 4(4):316, pl. XLI, fig. 15, pl. L, fig. 5; McDunnough, 1939, Check List of Lep., part 2:37 (syn. of *brachymorpha* Meyr.); Lange, 1939, South. Calif. Acad. Sci. Bul., 38:159, pl. 35, fig. 2, 2a, 4 (fig. male, female genitalia).
- seeboldi* Hofmann, 1898, Iris (Dresden), 11:33-34 (*Amblyptilia*); Rebel, 1901, Cat. Pal. Lep. 2:73 (no. 1340).
- terlizzii* Turati, 1926, Soc. Ital. Sci. Nat. Ann., Milano, 65:67-68, fig. 28; Turati, 1932, Ent. Soc. Ital. Boll., 64:59 (distinct sp.?).

Male. Primaries, in general, a brownish gray, with the usual triangular mark faintly indicated and a dark dash before outer white line basally, at center of first lobe; scale tuft of third lobe of secondaries just before apex with scattered dark scales to base. *Head* with palpi ascending, brown with lighter scales below on first segment and at end of second segment; second segment tufted below and above; third segment distinct, yellowish white in color; frontal tuft short, truncate in front; antennae brown, slightly banded basally, ciliate. *Thorax* buff to buff-brown, lighter behind. *Primaries* a brownish gray with usual triangular mark feebly indicated, cleft to about one third, first lobe slender, with a light brown area following triangle and a dark dash basally just before transverse white line; beyond white line, fringes grayish white with dark bases to the wavy termen; second lobe with three dark patches of scales on termen, the one at the anal angle prominent; scattered dark scales in grayish white fringe of inner margin. *Secondaries* a uniform gray-brown with dark bases to fringe on outer margin of first lobe; second lobe narrowed apically; third lobe with a subtriangular group of black scales just before apex and a few scattered dark scales to base. *Abdomen* with first segments yellowish white, the rest a buff with darker scaling and a few dark dots at posterior margin of some segments. *Legs* long, slender, with long spurs; forelegs with femora dark brown, but tibiae with a dark stripe on outer side, extending down tarsal segments; middle legs with dark stripe down tibiae as in forelegs continuing down first tarsal segment; rest of tarsal segments fuscous; tibiae with long spurs apically; hind legs dark brown outwardly, with first pair of spurs very long and slender, second pair shorter; tarsal segments uniform light brown to white.

Expanse. 9-16 mm.

Female. Essentially as male.

Male genitalia. Of the same type as *antirrhina* Lange, but much smaller. Harpes with finger-like process at apices; cucullus broad, subrectangular; uncus very slender, pointed apically; anellus lobes are two slender processes attached basally to a basal plate; sacculus not produced, slightly grooved below; aedeagus very long, slender.

Female genitalia. Posterior apophyses practically absent; ostium arises at center of genital plate with the outline of abdominal segment VII not grooved medially as in *antirrhina*; ductus bursae wide near ostium, then narrowed to bursa; bursa with two long, slender signa, which have little indication of tooth-like projections.

Types. The types of *crenulata* B. & McD. are in the U. S. National Museum.

Material examined. Three cotypes borrowed from the United States National Museum, March, 1940, through the courtesy of August Busck, with the following data: No. 1, female, Everglade, Florida, April 1-7; no. 2, male, Fort Myers, Florida, May 1-7; and no. 3, female, Chokoloskee, Florida; one male, same as type series, Chokoloskee, Florida (Lange collection); one male, Pusa, India, February 13, 1932 (sent as *P. taprobanes* Felder by T. B. Fletcher); and one female, Pepper Sauce Canyon, Catalina Mountains, Arizona, August 16, 1924, E. P. Van Duzee, collector (San Francisco Academy of Sciences collection).

California distribution. I have not seen any California material. Barnes and Lindsey (1921) list one specimen from San Diego in southern California.

Extra-California distribution. In the United States records outside of California are available only from Florida where the type series was taken, and for Arizona where Barnes and Lindsey recorded it from the Santa Rita Mountains in May (cotype of *marmarodactyla* Dyar), and in Yuma County in May. The writer has seen a single Arizona specimen from the Catalina Mountains, in August. It probably occurs in the intervening Gulf states, and will be found when a thorough search in this region is made.

Under the name of *brachymorpha* Meyrick, this species, according to Meyrick (1913), is found in South Africa, Mauritius, Syria, India, Ceylon and Hawaiian Islands.

As *taprobanes* Felder, Fletcher lists the following additional localities for this species: Queensland, Brazil, Florida, Arizona, S. California, Algeria, Cyrenaica and Cyprus. He also mentions that in Ceylon, India, and Burma this species occurs mostly in the plains but ascends into the hills in the south.

Discussion. In the synonymy presented here I am following Fletcher (1931, 1932) who has had access to Felder's type of *taprobanes*.

The male genitalia of the Indian specimen seems to be very close if not identical with that of *crenulata* B. & L., although final judgment should be reserved until further material can be examined. The Indian specimen is grayer than those of *crenulata* I have seen, and the transverse white line of the second lobe of the primaries is more oblique, but these variations may well be within the range of variation of the species.

Turati (1932, Ent. Soc. Ital. Boll., 64:59) considers his *terlizzii* as distinct, and *acanthodactyla* var. *phoenicodactyla* Chrétien may be a distinct species.

Biology. The biology is not known in the United States. The host plants in the literature include the following (see Fletcher, 1931):

Celsia coromandeliana (in flowers), *Limnophila heterophylla* (in fruits), *Pentstemon* (in seeds), and *Veronica anagallis* (in unripe fruits).

The larva and pupa are described and figured by Fletcher (1932). The larvae were found in January, April, August, and September, boring into the fruit of *Limnophila* and *Veronica* and the unripe seeds of *Pentstemon*.

Platyptilia antirrhina Lange

(Plate 1, e; plate 2, e; plate 3, c; plate 7, d; plate 13, j; plate 16, g)

antirrhina Lange, 1939, South. Calif. Acad. Sci. Bul. 38:157-63, fig. (includes biology);

Lange, 1942, Jour. Econ. Ent. 35(5):721-22, fig. 1(2), fig. 2, B, fig. 3, B, fig. 5.

marmarodactyla, Essig and Hoskins, 1934, Calif. Agr. Ext. Serv. Cir. 87:79 (misidentification), (host, control).

Male. Small, grayish brown, roughly scaled, with the usual triangular mark indistinct, and a characteristic dash on first lobe; transverse white line through both lobes, wavy, indistinct; most closely related to *taprobanes* Felder. *Head* with palpi ascending; first palpal segment white-tipped below and above, second segment white-scaled below and with a tuft of scales projecting forward under first segment; third segment evident, white-tipped; frontal tuft short, subtruncate at end; tuft of scales between antennae on head, giving rough appearance, antennae brown with tufts of white scales, giving a banded appearance, and with white scaling on undersides at base. *Thorax* grayish brown, mesothorax fuscous on dorsum, and metathorax white above. *Primaries* dull grayish brown to fuscous; usual triangular mark present, but not sharply differentiated; first lobe with a light spot on costa just beyond triangle, then a dark costal area with scattered white scales to just before the transverse thin, white, subterminal line; toward cleft at center of first lobe, a black dash with base on transverse line; area beyond transverse white line on first lobe composed of brown, gray, fuscous, and whitish scales; second lobe composed of mixed fuscous, white, and brown scales; apex produced slightly into a peak; termen with a wavy appearance, especially on second lobe; fringes grayish white, on outer margin with dark bases, and anal angle with dark scales emphasized; fringe of second lobe interrupted with two patches of white scales; cleft with fringes grayish white, with dark scale patches at outer angles; inner margin with two tufts of dark scales and a few scattered dark scales basally. *Secondaries* and fringes a dull, grayish brown with darker bases to fringes on outer margin of first lobe; second lobe narrowed apically, but not to such a degree as in *taprobanes*; third lobe with a subtriangular patch of dark scales just before apex, and scattered black scales to base of wing. *Abdomen* with first segments yellowish white, the rest rough scaled, composed of white, fuscous, gray, and brown scales; a dark patch of scales on dorsum of posterior margin of most segments. *Legs* long, slender, spurs well developed; forelegs with the femora long, brown, the tibiae short, with a distal tuft of scales and a dark streak extending down to end of tarsal segments; middle legs also show the banded effect, tibiae long with a tuft and a pair of spurs apically; hind legs generally fuscous, the first pair of spurs long, with outer spines longer; the second pair of spurs shorter, more robust, tipped with fuscous; the tarsal segments are darker at the terminal junctions of the segments.

Expanse. 15-19 mm.**Female.** Essentially as male.

Male genitalia. Of same general type as *taprobanes* Felder, but the structures larger. Harpes with beak-like cucullus at apex; sacculus wide, narrowed toward base. Uncus slender, beak-like apically. Anellus lobes well developed

as two slender processes with a distal projection and basally united with the triangular basal plate (juxta). Saccus not developed, grooved at base. Tegumen narrow. Aedeagus long, slender, slightly enlarged apically, distinctly more robust than in *taprobanes*.

Female genitalia. Same type as *taprobanes*. Ovipositor lobes wide, with numerous long setae. Ostium arising from center of genital plate. Outline of abdominal segment VII, incurved, in contrast to straight outline in *taprobanes*. Basal part of ductus bursae enlarged, sclerotized, distally becoming a transparent tube. Bursa copulatrix with signa very long, slender, with saw-tooth edge, especially basally.

Types. In California Academy of Sciences collection, San Francisco (Holotype: No. 5061; allotype: No. 5062).

Material examined. California, 117 specimens; Oregon, 2 specimens.

Distribution.⁶ This species, up to the present time, has been recorded from California only on cultivated snapdragon, where it is particularly abundant in the San Francisco Bay area in home gardens and greenhouses. The records of counties where collections of adults have been made are tabulated as follows: Alameda (April, July, August, September, October, November), Contra Costa (October), Lake (February, March, April, May, June, July, August, September, October), Los Angeles (September), Marin (June), San Mateo (July), Sonoma (March, April, May, September, October, November), and Yolo (August).

Biology. This insect has been known in California for a number of years as the "snapdragon plume moth" although it has been called a number of names. The writer first became aware of this moth in 1933, when a graduate student, Mr. Jack Bongberg, undertook some special research work on biology under the name of *Platyptilia acanthodactyla* Hübner. Since this time it was found in the San Francisco Bay area and other areas in gardens, where it caused minor injury. Since about 1939 the moth has been causing significant losses in certain greenhouses in the San Francisco Bay area which specialize in the culture of snapdragons.

In 1939 the writer presented this insect as a new species, the adults being reared from snapdragon collected at Kelseyville, Lake County, California, where it was found in gardens. This paper also presented the chief points in the biology, and figured the egg, larva, pupa, adult, and male and female genitalia. For completeness, the description of the immature stages is included here, and also additional features in the life history which have been observed since the earlier paper.

Food plants. The only known food plant is the cultivated snapdragon, *Antirrhinum* sp., where the larvae are leaf miners in their earlier stages and later become borers in the stems, petioles, green seed pods, or flowers.

Description of the immature stages. The egg is ovate to elliptical, glossy, pale yellowish in color, and in size from 0.24 to 0.26 mm. wide and 0.39 to 0.44 mm. long. The surface of the egg is covered with hexagonal reticulations which are quite distinct.

⁶ Since this paper was submitted Mr. John Davis (Newsletter to Nurserymen, 57:4, 1949) found this species damaging snapdragon at Yachats, Oregon, and feeding on the leaves of *Linaria cymbalaria* at Salem, Oregon.

Four larval instars are found, the larvae molting three times.

The first instar larva is 0.97 mm. long, and 0.18 mm. wide at the thorax. It is a pale yellowish green in color, with the head reddish brown and the cervical shield and anal plate light brown. All the legs are concolorous with the body. The setigerous tubercles are brown and conspicuous.

The second instar larva is 1.76 mm. long (extended) and 0.22 wide at the anterior end. In other details it is essentially like the first instar.

The third instar larva is 3.08 mm. long and with a width of 0.53 mm. at the thorax. The head, cervical shield, and anal plate are brown, with the body green. The primary setae are long, white, slightly smaller apically, arising from brown, conical tubercles. The legs are the same as in previous instars. The spiracles are dark-ringed and slightly raised.

The fourth instar larva is 9 to 10 mm. long, with a width of 1.58 mm. at the first abdominal segment. Two color forms are found, a green form and a rarer purplish-red form. The body tapers to both ends from the second and third abdominal segments. The primary setae are long, white, have slightly swollen apices, and arise from black tubercles. Markings include a dorsal longitudinal line, which is the dorsal vessel showing through, two somewhat interrupted subdorsal whitish lines and a substigmatal whitish line. The head is green with darker ocelli. The legs are concolorous with the body, and the spiracles are raised and black-ringed. Verrucae are present, showing a tri-setose prespiracular setal group (Kappa group) on the prothorax (bisetose in some specimens), and for setae IV-V and VII on certain segments. The crochets of the prolegs are arranged in a uniordinal semicircle and are 9 to 10 in number.

The pupae vary from brownish to pinkish white in color, and in length from 8 to 10 mm. A variable amount of fuscous suffusion occurs in different individuals, but usually there are two dark blotches on each side of abdominal segments 1 to 3, with variable dark markings on the wing cases, appendages, and thorax. There is a subdorsal dark line on the abdomen and a similar substigmatal line. On the prothorax are two converging ridges which extend posteriorly to abdominal segment 3. The abdominal segments 1 to 7 have on each side of the dorsum a pair of anteriorly projecting spines. The cremasteric end is dorsally grooved and has two areas of attachment composed of numerous hooked setae. In morphological details the pilifers are present as side lobes below the labrum, the mesothoracic legs extend to the sixth abdominal segment, and the metathoracic legs are reduced.

Life history and habits. The eggs are laid any place on the plants, but are usually placed on the newly forming flowers or on the undersides of the leaves on the terminal young growth. Upon hatching, the larvae become leaf miners feeding inside the leaves where they are easily seen, and remain as leaf miners for the first, second, and sometimes the third, instars. Some larvae can omit the leaf mining stage when flowers or green seed pods are present and bore directly inside these structures. The larger larvae may bore for considerable distances in the stems, or into the flower structures or green seed pods, where they do considerable injury. Upon completing their development the larvae usually pupate externally on the stems, petioles, or flower parts, hanging head downward from these structures.

The adults are weak fliers, usually remaining on or fairly close to the food plants. They are more active on warm evenings, when they can be observed flitting about among the plants. Ideal conditions are present in greenhouses where the temperature is higher during the early part of the evening when they are most active.

Duration of the stages. The first complete life history records of this moth were completed during the fall of 1938 and the spring of 1939. Larvae were reared in Stender dishes on pieces of snapdragon foliage and flower parts

TABLE 2
DURATION OF STAGES OF *Platyptilia antirrhina* LANGE AT HALF MOON BAY AT
OUTSIDE TEMPERATURES, 1938-1939*

Date hatched	First molt	Second molt	Third molt	Prepupal	Pupated	Adult emerged
Nov. 8, 1938.....	Dec. 11, 1938	Jan. 4, 1939	Mar. 21, 1939	.....	Mar. 27, 1939	May 15, 1939
Nov. 8, 1938.....	Dec. 11, 1938	Dec. 23, 1938	Mar. 21, 1939	Apr. 18, 1939	Apr. 23, 1939	May 19, 1939
Nov. 11, 1938.....	Dec. 1, 1938	Dec. 11, 1938	Mar. 1, 1939	Mar. 21, 1939	Mar. 29, 1939	Apr. 27, 1939

* Larvae reared in Stender dishes on snapdragon foliage and flower parts. The average time elapsing from hatching of the egg to emergence of adult, for these rearings, was 182.6 days.

TABLE 3
DURATION OF STAGES OF *Platyptilia antirrhina* LANGE AT INSIDE LABORATORY
TEMPERATURES, HALF MOON BAY, 1940*

Date hatched	First molt	Second molt	Third molt	Pre-pupal	Pupated	Adult emerged	Sex
Apr. 28.....	May 6	May 12	May 17	.....	May 24	June 4	Female
Apr. 28.....	May 6	May 10	May 17	.....	May 24	June 7	Male
Apr. 28.....	May 6	May 12	May 20	May 24	May 26	June 7	Female
Apr. 28.....	May 6	May 12	May 17	May 24	May 26	June 9	Male
Apr. 28.....	May 6	May 12	May 16	May 22	May 23	June 4	Male
Apr. 28.....	May 6	May 10	May 17	May 22	May 24	June 5	Male
Apr. 28.....	May 8	May 12	May 17	May 30	June 1	June 13	Female

* Larvae reared on foliage and flower parts of snapdragon in Stender dishes kept at inside temperatures. The average time elapsing from the hatching of the egg to emergence of the adult for these rearings was 40.4 days.

TABLE 4
DURATION OF STAGES OF *Platyptilia antirrhina* LANGE AT OUTSIDE
TEMPERATURES, HALF MOON BAY, 1940*

Date hatched	First molt	Second molt	Third molt	Prepupal	Pupated	Adult emerged
Apr. 28.....	May 7	May 21	May 25	June 5	June 5	June 20
Apr. 28.....	May 7	May 21	May 27	June 5	June 7	June 28
Apr. 30.....	May 7	May 20	May 27	.....	June 5	June 19
Apr. 30.....	May 7	May 20	May 27	.....	June 5	June 20
Apr. 28.....	May 7	May 20	May 27	June 4	June 5	June 22
Apr. 28.....	May 7	May 20	May 27	June 4	June 7	June 20
Apr. 28.....	May 6	May 20	May 27	June 4	June 7	June 20

* Larvae reared on foliage and flower parts of snapdragon in Stender dishes kept at outside temperatures. The average time elapsing from the hatching of the egg until emergence of the adult for these rearings was 53.7 days.

which were kept at outside temperatures at Half Moon Bay. These rearings are presented in tables 2, 3, 4. During April to June 1940, the life history was again successfully completed, with a comparison being made between outside and inside temperatures at Half Moon Bay. These rearings are presented below. The egg period during these studies varied from 10 to 14 days at laboratory temperatures, and 12 to 21 days at outside temperatures.

Seasonal cycle. The generations of this insect are not distinct: there is considerable overlapping in stages. At Kelseyville, Lake County, small larvae overwinter in a protected manner as leaf miners. The first adults emerge during April and continue to emerge into May. A summer generation is apparently completed in a short time, as by the latter part of July mature larvae are found, with pupae and adults in August and September. The fall generation apparently ends in November and December, with larvae of the overwintering generation beginning as leaf miners in November. Apparently there are three generations a year in this region.

In greenhouses the life history is apparently completed in a shorter period of time, allowing additional generations to be completed in a year with a peak usually in August and September.

Natural enemies. No parasites have been reared from this species although numbers of larvae have been collected in the field.

Platyptilia pica pica (Walsingham)

(Plate 7, b; plate 16, i)

pica Walsingham, 1880, Pter. of Calif., Ore., p. 21-23, pl. II, fig. 1 (*Amblyptilus*); Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4561); Fernald, 1898, Pter. N. A., p. 24; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:442 (no. 4936); Anderson, 1904, Cat. Brit. Col. Lep., p. 50 (no. 986); Brit. Col. Ent. Soc. Check List, p. 42; Meyrick, 1910, Gen. Insec., fasc. 100:11; Meyrick, 1915, Wagner's Lep. Cat., pars 17:13; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5866); McDunnough, 1939, Check List of Lep., part II:37 (no. 6485).

Female. A contrasty black and white form with distinctive white and black markings on the abdomen. *Head* with grayish-brown and white scales; palpi slightly ascending with third segment turned downward; first segment brown with white scales below and above; second segment with a few white scales above; third segment projecting beyond front, brown with white apices; frontal tuft moderate, rounded in front, brown with whitish scales; antennae banded, dark brown with whitish scale tufts. *Thorax* grayish brown with white scales, and a characteristic dark spot at the center of each tegula; a black dash on each side of metathorax. *Primaries* before the triangle varying from almost white with a mottled costal margin and some fuscous suffusion basally, to specimens having more distinct markings, including a darker costal margin with scattered white scales, a basal black dash and a dash below cell, and a dark dash in cell at one third from base; triangular mark black to dark brown, triangular or almost square; area beyond triangle is light; a dark band through both lobes outlined on outer side by the outer white line; beyond white line fuscous, with a lighter line running to apex; apex acutely produced, but not as much as *punctidactyla*; fringes of outer margin grayish brown with dark bases, and on both lobes interrupted by two white patches of scales;

fringe of cleft dark grayish brown with scattered fuscous scales, and a white patch at anal angle of first lobe; anal angle of second lobe with a conspicuous tuft of dark scales; fringe of inner margin white with two well-developed dark scale tufts, the inner one larger, with scattered dark scales basally and a dark patch just before anal angle. *Secondaries* with fringe brownish gray; third feather with a line of white scales running horizontally along inner margin, a well-defined triangular black scale tuft beginning just beyond center of lobe, outlined on inner side with white scales, a dark inconspicuous tuft at apex, and scattered dark scales from triangular tuft to base of wing. *Abdomen* white above with a black Π -mark on segments 2 and 3; segment 4 with a black dash on each side with the line continuing laterally to end of seventh segment; laterally can have a more or less continuous black line or just black dashes as lateral extension from the dorsal marks; ventrally white, especially toward end of abdomen, or can be brownish with white scales at posterior margins of segments. *Legs* distinctly banded, forelegs with tibiae partially dark striped in front with tibiae greatly enlarged apically; middle legs with dark patch at center of tibiae and at origin of distal spurs; spurs well developed; hind legs brown with white scales; darker banded before origin of spurs and with a lighter patch just after; spurs rather stout, dark tipped apically; tarsal segments whitish or with posterior part of first segment and last two segments darker.

Expanse. 17–25 mm.

Male. A single male from Wellington, British Columbia, has more fuscous suffusion, and less contrasting markings.

Male genitalia. Harpes in this group characteristic; broad, blade-like, with a narrower cucullus armed with a sharply pointed spine-like process which projects downward from the outer side; sacculus extending to the cucullus. Uncus blade-like, wider apically, with numerous sharply pointed spines. Anellus lobes above are lobe-like with a few distal spines; below with upwardly projecting flaps set with numerous spines; and ventrally come together in a curved juxta or basal plate. Tegumen above with a dividing suture. Aedeagus characteristic; short, curved, inflated basally, and terminally enlarged, then gradually narrowed to apex, and set with teeth.

Female genitalia. Ovipositor lobes rather wide, with numerous long setae. Anterior apophyses short, pointed at tips. Posterior apophyses, reduced to just a small spine, continued posteriorly on each side as a supporting rod on genital plate. Genital plate produced posteriorly, bilobed medially. Ostium arising on right side. Copulatory pouch wide at base, then slightly narrowed to form a sclerotized elongated tube. Ductus bursae distally narrowed, but not strongly sclerotized. Bursa copulatrix with two greatly elongated signa, which are minutely toothed.

Types. In the British Museum.

Material examined. Ten specimens, all from British Columbia (Vancouver Island).

California distribution. Walsingham described *pica* from three specimens collected in a forest of coast redwood about June 20, 1872, near Crescent City, Del Norte County, California. A specimen that approaches the typical insect was reared by the writer from *Stachys* from a larvae collected June 21, 1940,

at Prairie Creek, Humboldt County, California, the imago emerging July 9 of the same year. This specimen is darker than the typical British Columbia specimen and has more dark suffusion on the abdomen. In addition, occasional specimens of what are considered on a quantitative and habitat basis as belonging to other subspecies are similar to *pica pica*. Such specimens observed are listed as follows: Forest Glen, Trinity County, June 24, 1938, 1 female; Greenville, Plumas County, September 9, 1920, 1 male; Norden, Nevada County, reared from *Castilleia miniata*, September 15, 1941, 1 female; and Pinnacles, San Benito County, May 16, 1939, 1 female.

Extra-California distribution. It is the typical form apparently on Vancouver Island, British Columbia, with Wellington specimens being the most typical. The data concerning the British Columbian material examined is as follows: Wellington, June 8, 1902, 1 female, G. W. Taylor; Wellington, May 1-7, 1 female; Wellington, June 8, 1902, 1 female; Wellington, June 9, 1905, 1 male, 1 sex unknown (probably male), G. W. Taylor; Sannichton, July 4, 1922, 2 females, J. G. Colville; Fitzgerald, April 17, 1921, 1 female, B. H. Blackmore; and Victoria, May 12, 1922, 2 females, B. H. Blackmore.

Discussion. The *pica* complex in North America is one of the most interesting problems and also one of the most trying to handle satisfactorily of any of the many problems in this genus. Our North American species in the past have been called the European *acanthodactyla* (Hbn.), and *punctidactyla* (Haworth), the former referring to California specimens which are more of a uniform dull brown, and the latter referring to the black and white specimens with much more distinctive markings.

The writer first became aware that only a single variable species was involved in California when both species, so called, could be reared from eggs laid by a single "*acanthodactyla*" female. Specimens were submitted to T. Bainbrigge Fletcher and in 1940 Fletcher described the California material as a distinct species, *crataea*, the specimens being reared from *Scrophularia californica*, *Antirrhinum*, and *Castilleia latifolia* at Half Moon Bay.

Platyptilia pica (Walsingham) has been kept as a separate species by previous workers because of the characteristic markings, and Grinnell (1908) named *monticola* which Barnes and Lindsey (1921) placed as a synonym of *punctidactyla*.

Since Fletcher described *crataea* he has kindly sent a series of European material of *acanthodactyla*, and adults and larvae of *punctidactyla*, which has enabled the writer to adequately separate these from our North American species.

The writer is using *pica* of Walsingham to include all of our western North American specimens in this group, referring to the different forms as races or subspecies. Over 500 reared specimens have been examined from California and, in addition, material from the state of Washington and various Canadian localities.

These studies indicate that the European *acanthodactyla* and *punctidactyla* are distinct species, and that *pica* is more closely related to *punctidactyla*. The genitalia of *punctidactyla* are extremely close to our species. The more slender lobes of the forewings with the distinctly more acute apices and the differences in the larvae will readily separate the two.

The writer feels that *pica pica* (Walsingham) should include certain darker individuals which are collected in the identical habitat as typically marked individuals. There also seems to be a tendency for the typical form to occur more frequently in the females.

Because of inadequate series of the Canada, Oregon, and Washington specimens the writer will only describe the typical species, and then the different races or subspecies that occur in California where long-bred series are available. Until long series are available for these other localities it is perhaps best to refrain from an attempt to erect subspecies.

The variation in the present complex seems to be one of an ecogenotypical nature, as was found for butterflies by Hovanitz (1941). That genetic factors are very important was observed when larvae brought to Half Moon Bay or Berkeley for rearing produced adults corresponding to their origin, and did not change in color or pattern in the different environment.

Genitalia mounts, both male and female, and cleared mounts of the larval skins have been made for all of the California subspecies, and no morphological differences of specific distinctness have been observed.

The biology of the species as a whole is interesting in that members of the plant family Scrophulariaceae are the usual food plants, although other plants in the families Geraniaceae, Primulaceae, and Labiatae can be selected.

The method of determining subspecies or races has been one based upon a quantitative analysis of specimens and on habitat. The variation is so great in this group that if no locality data were available, moths reared from eggs laid by a single female could be assigned to several subspecies. Obviously the race is determined on the basis of the total population, and specimens are considered as being a subspecies, even though the color and pattern of an individual might place it in another subspecies. The evidence obtained to date indicates that *pica pica* (Walsingham) is a population on Vancouver Island, British Columbia, which contains 82 per cent of typical forms and 18 per cent of darker individuals. The only other way to interpret Walsingham's *pica* would be to consider it a contrasty form of a coastal subspecies. It would seem more desirable to consider the typical species as a subspecies and, for the time being at least, consider it as typical of a more northern habitat. The logging operations with the consequent burning of the vegetation and change in environmental conditions have considerably changed the Crescent City region from the days when Walsingham collected his material of *pica*. The writer has made several trips to this region and still has to rear typical *pica* from the type locality.

With further collecting it is very possible that the exact limitations of the different subspecies will change, as the present concepts can be based on available material only.

Biology. The only biological notes with which the writer is familiar which can refer to *pica pica* (Walsingham) were published by Day (1928) under the name of *punctidactyla*. His observations were made at Duncan, Vancouver Island, where the typical species should occur. Day found larvae on May 19, 1926, feeding inside the green seed pods of *Dodecatheon pauciflorum*. He noticed several color forms of the larvae, from green to rose, which is found in the other subspecies of this insect.

It is interesting to note that Day (1928) found a considerable variation in the color of the specimens. To quote him:

"It is seen by an examination of the insects in the box I have brought that the specimens vary extensively, *inter se*, but they are mostly from larvae found about the same time and about the same place. A rather interesting question arises therefore as to whether they represent varieties of one species or whether they can be differentiated into two species as at present accepted, namely *P. punctidactyla* and *P. pica*."

Day's observations are pertinent, as considerable variation has been found by the present writer in individuals of the California subspecies; and they also indicate that perhaps the true *pica* should include duller-marked specimens from the same locality as is indicated in the specimens before the writer.

The results of certain crossbreeding experiments will be presented later in the paper. Certain subspecies were satisfactorily crossed, although others would not mate or lay eggs even *inter se*.

Platyptilia pica calisequoiae Lange, new subspecies

Male. Characterized by a general brownish suffusion of the primaries, head and abdomen, with the costal margin dotted with spots of lighter scales. It differs from *crataea* in the warmer tone of the brown, and more distinctive costal spotting.

Expanse. 19–23 mm.

Female. In general of colder shades, with olive green to blackish suffusion, but the main features as in the male.

Types. *Holotype*, male, reared from a larva collected on *Stachys*, June 22, 1940, at Hiouchi State Redwood Park, Del Norte County, California, the adult emerging July 16, 1940 (W. H. Lange). *Allotype*, female, with same data.

Paratypes as follows: 9 males, 9 females, same data as holotypes; one female, Smith River, Del Norte County, collected as pupa June 24, 1940, on *Scrophularia californica*, the adult emerging July 3, 1940; one female, reared from larva on *Stachys*, collected June 5, 1939, at Prairie Creek State Park, Humboldt County, the adult emerging July 14, 1939; and 4 females, with the same data, collected as larvae on June 21, 1940, adults emerging July 11, 12, and 23; 1 female, collected as larva on *Stachys* at Klamath, Del Norte County, June 21, 1940, the adult emerging on July 14, 1940; 1 female, Mendocino, Mendocino County, flushed from *Stachys* on June 20, 1940; 1 male, reared from *Castilleja latifolia*, from a larva collected June 24, 1940, at Mendocino, the adult emerging July 12, 1940.

The types will be deposited in the California Academy of Sciences, San Francisco.

Discussion. This name is proposed for a population found feeding chiefly on *Stachys* species in the shade of coast redwood forests from Del Norte County to Humboldt County, and extending out of the redwood belt in Mendocino County.

It is possible that Walsingham's *pica* is a contrasty form of this subspecies, but due to the lack of evidence and the fact that only one specimen in the series approaches *pica*, and this from Humboldt County, the writer is placing them in the present race. In Hiouchi redwoods, a short distance from Crescent

City, where typical *pica* would be expected to be found, the entire population has the brownish suffusion characteristic of *calisequoiae*.

The quantitative analysis of the specimens in the tabulation below shows the following distribution of color phases in *calisequoiae*.

Color	Per cent of population	
	(Female)	(Male)
Olive gray.....	52.6	27.3
Brown.....	31.6	72.7
Fuscous.....	10.5	0.0
Black and white.....	5.3	0.0

Biology. The larvae of *calisequoiae* feed more or less externally among the flowers of the host plants (which have already been listed), webbing the flower parts, and when mature pupating externally on the stems or from the undersides of the leaves. Mature larvae were found most abundantly during June, and most of the larvae were of the green form.

The life history is apparently similar to that of *crataea*, which will be presented under that species in more detail.

At Carlotta on the Van Duzen River, and at Prairie Creek, Humboldt County, the same parasite, *Apanteles insignis* Muesebeck, which was found at Half Moon Bay on *crataea*, was a most effective natural enemy of the larvae. At Carlotta on July 9, 1941, 37.5 per cent of the larvae were parasitized by this braconid.

Platyptilia pica marina Lange, new subspecies

Male. Similar to *pica pica*, but with the markings less contrasty due to a brown suffusion, and the body darker. Head grayish brown with whitish irroration. Thorax with a black dash on each side of mesothorax and lighter before first abdominal segment. The primaries show a costal dotting, and on the basal part of wing an indistinct series of transverse white dashes. Abdomen fuscous to black, with indication of 3 black A-shaped markings.

Expanse. 20–25 mm.

Female. As male.

Types. *Holotype*, male, reared from a larva collected on *Castilleia latifolia* at Fort Bragg, Mendocino County, California, on June 20, 1940, the adult emerging July 13, 1940. *Allotype*, female, with same data, the adult emerging June 15, 1940.

Paratypes as follows: 34 males, 40 females, same data as holotype, adults emerging from July 12–28, 1940; 21 males, 15 females, collected as larvae on *Castilleia latifolia* on June 20, 1941, at Albion, Mendocino County, the adults emerging from July 12–21; 2 males, 1 female, collected as larvae on *Mimulus guttatus* at Albion, on June 20, 1940, the adults emerging July 12, 1940; and 1 female, collected as larva on *Stachys chamissonis* at Little River, Mendocino County, on August 31, 1941, the adult emerging September 15, 1941.

Types to be deposited in California Academy of Sciences, San Francisco.

Discussion. This subspecies seems intermediate between *pica pica* and a form from Mt. Baker, Washington, and inland Canadian localities, so far as coloration is concerned. This relationship is indicated in the banded effect of the primaries and is especially well developed in the Washington specimens.

The Albion specimens are more smoky brown in coloration, but are included in this subspecies because the other features are essentially the same.

Out of the entire group only one brown individual was reared, or 0.8 per cent of the population is more like *calisequoiae* or *crataea*.

Biology. The life history is similar to that of the other subspecies. The food plants have been listed under "types." The populations on *Castilleia latifolia* are quite large, and this is the usual food plant of this subspecies. The larvae are parasitized by the braconid, *Apanteles insignis* Muesebeck, which already has been mentioned.

Platyptilia pica sierrae Lange, new subspecies

(Plate 1, f; plate 2, c; plate 7, e)

Male. Characterized by the small size, and the grayish to fuscous irroration of the primaries. Head grayish brown with a few white scales. Thorax grayish fuscous with a black streak on each side of metathorax followed by white before first abdominal segment. Primaries before triangle, a uniform grayish fuscous, with the costal edge not distinctly spotted as in *marina*; outer line only faintly indicated. Abdomen grayish fuscous with white scale patches, and on dorsum black scales at posterior margin of segments. Legs with white areas somewhat darkened by grayish-brown scales. Undersurface of secondaries with outer transverse light line only faintly indicated.

Expanse. 12–21 mm.

Female. As male, except the black Λ -marks on the abdomen are more conspicuous.

Type. *Holotype*, male, collected as pupa on *Castilleia miniata* at Emigrant Gap, Placer County, California, on August 10, 1941, the adult emerging August 27, 1941. *Allotype*, female, with same data, collected as larva, the adult emerging September 15, 1941.

Paratypes as follows: 3 males, collected as larvae on *Mimulus lewisii* at Carpenter Flat, Placer County, on August 10, 1941, the adults emerging from August 22 to 25, 1941; 15 males, 33 females, collected as larvae and pupae on *Castilleia miniata*, at Emigrant Gap, Placer County, on August 10, 1941, the adults emerging from August 20 to September 15; 12 males, 21 females, collected as larvae on *Castilleia miniata*, west of Norden, Nevada County, on August 10, 1941, the adults emerging from August 25 to September 15, 1941; 8 males, 11 females, collected as larvae on *Castilleia miniata* at Deer Park Springs, Tahoe National Forest, on August 10 and 11, 1941, the adults emerging from August 20 to September 3, 1941; 9 males, 15 females, collected as larvae on *Castilleia miniata*, at Lake Tahoe, the adults emerging from August 24 to September 3, 1941; 2 males, 3 females, collected as larvae and pupae on *Castilleia linearifolia* on Tioga Pass, elevation 8,000 feet, on August 13, 1941, the adults emerging from August 13 to September 11, 1941; 1 male, collected as larva on *Castilleia* sp., at Porcupine Flat, Yosemite National Park, August 13, 1941, the adult emerging August 29, 1941; 7 males, 6 females, collected as larvae on *Castilleia miniata* at Lake Mary, Mammoth Lakes, on August 14, 1941, the adults emerging from August 27 to September 3, 1941; 2 females, collected as pupae on *Castilleia miniata* at Hilton Park, Mono County, the adults emerging August 27, 1941; 1 female, collected as larva on

Castilleia sp., at Crescent Meadow, Sequoia National Park, the adult emerging August 21, 1941; 2 males, 6 females, collected as larvae and pupae on *Castilleia miniata*, at N. Fork, Stone Creek, San Jacinto Mountains, on August 17, 1941, the adults emerging August 20 to September 11, 1941; 1 female, same data, collected as larva on *Stachys rigida*, the adult emerging September 3, 1941; 1 male, 1 female, collected as larvae on *Castilleia affinis* (?) on Vassar Creek, east of Hopland, Mendocino County, on May 26, 1941, the adults emerging June 11, 1941; 1 male, collected on Mt. Shasta, Siskiyou County, July 6, 1941 (William Bauer); 1 male, collected at Greenville, Plumas County, September 8, 1920 (J. Clemons).

Discussion. There is considerable variation in the degree of grayish-white irroration and in the markings on the abdomen, but the general coloration is quite constant. Certain specimens agree with those from Fort Bragg in being rather a unicolorous fuscous. In the entire series of the 165 specimens only 3, or 1.8 per cent, resembled *pica pica*, and no brown forms occurred.

Biology. The larvae are general feeders on members of the plant family Scrophulariaceae as can be seen in the previous paragraph, and also feed on certain members of the Labiatae.

It is an abundant form in the Sierra Nevada mountains, especially on *Castilleia* species.

The life history is apparently similar to that of *crataea*, differing probably in the number of generations a year, but the larval habits and immature stages seem identical. Both green and reddish larval forms are found.

The eggs are laid on the undersides of the leaves on the stems or flower parts. Although the small larvae may feed internally in the flowers or green seeds, the mature larvae are more external feeders, webbing the flowers or green seeds together. Pupation occurs nakedly, suspended from the stems or leaves.

The braconid, *Apanteles insignis* Muesebeck, is a larval parasite, as occurs in the other subspecies of this insect.

Larvae of this subspecies were found on *Mimulus guttatus* at Carpenter Flat, Placer County, on August 10, 1941, but no adults were reared. A larva was also collected on *Mimulus lewisii* at Tioga Pass, Yosemite National Park, on August 14, 1941, but the adult was not successfully reared.

Platyptilia pica monticola Grinnell, new combination

(Plate 13, k)

monticola Grinnell, 1908, Can. Ent. 40(9):316 (new syn.); Meyrick, 1913, Wagner's Lep. Cat., pars 17:14; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5872).

Male. Characterized by the uniform light brown to grayish-brown color to the primaries, head, thorax, and abdomen, with the triangular mark not distinct, and the costal margin not mottled as in *calisequoiae*. *Thorax* light brown to grayish with a dark streak on each side of metathorax, followed by white before first abdominal segment. *Abdomen* with first segment lighter, rest brown to grayish brown with a few fuscous and white scales.

Expanse. 17–20 mm.

Female. As male.

Types. Two of Grinnell's "types" are in the U. S. National Museum, in rather poor condition, and were borrowed for the present study.

California distribution. This is apparently a race in southern California in the Upper Sonoran and Transition zones. I am associating with the types, specimens from Los Angeles (June, August, September), certain San Jacinto Mountain forms (August), specimens from Paso Pacheco State Park, San Diego County (August), and Snow Creek, Riverside County (November).

Grinnell's types were taken in the San Bernardino Mountains, July 1, 1907, at an elevation of 6,400 feet.

Discussion. Grinnell's *monticola* has been considered in the past as a synonym of *punctidaetyla* (Haworth), but the present study has shown it to be in the *pica* complex. The types have a grayish tinge which is lacking in many of the Herkey Creek, San Jacinto Mountains, specimens.

A specimen from Bouquet Canyon, Los Angeles County, collected June 26, 1939, by J. A. Comstock, is almost a match for the type.

Considerable color variation in the specimens is apparent, with gray and brown forms in one instance being reared from the same plant at the same time (Snow Creek, Riverside County, *Pentstemon*).

The series available is not large enough to evaluate the coloration statistically, but it does show the following percentages: light reddish brown, 20.6 per cent; gray-brown, 58.8 per cent; gray, 8.8 per cent; fuscous and white, 8.8 per cent; and dull brown, 3 per cent.

With further collecting the subspecies of southern California may have to be altered, but until that time we can consider *monticola* a race showing the effects of a hotter, drier climate.

Biology. The author collected a series at Herkey Creek, San Jacinto Mountains, on August 17, 1941, which had as a larval food plant *Stachys rigida*. No larvae were found, but adults and eggs were present on this date.

Dr. J. A. Comstock reared two specimens from *Castilleja* sp. in San Fernando, Los Angeles County, the adult emerging June 1, 1937. The other reared specimens are three from Snow Creek, Riverside County, from a *Pentstemon* species, by J. A. Comstock.

Platyptilia pica crataea Fletcher, new combination

(Plate 1, g; plate 2, a; plate 4, a; plate 7, a; fig. 6; fig. 7)

crataea Fletcher, South. Calif. Acad. Sci. Bul. 39(2):99-102 (new syn.).

acanthodaetyla, Lange, 1939, South. Calif. Acad. Sci. Bul., 38(1):24.

acanthodaetyla, Lange, 1939, South. Calif. Acad. Sci. Bul., 38(3):160 (host plants).

Male. Characterized by the dark smoky brown to reddish-brown primaries and body. *Head* and palpi dark brownish fuscous with a few lighter scales; antennae dark brownish fuscous with a few white scales basally. *Thorax* usually with two black dashes on metathorax followed by a lighter area. *Primaries* a uniform smoky fuscous to brown, with some specimens redder and a few showing a spotted costal margin; triangle somewhat intergrading basally into the general wing color. *Abdomen* smoky fuscous to black with lighter scales at first segment and scattered throughout, and in some specimens indications of the dark A-marks on the dorsum. *Legs* fuscous with lighter bands.

Expanse. 17–23 mm.

Female. As male.

Types. Type, male, in the Lange collection, as are six "cotypes." The other "cotypes" are in the Fletcher collection, England. The type of *crataea* will be deposited in the collection of the California Academy of Sciences, San Francisco.

Distribution. This subspecies is characteristic of a strip of coastal California, chiefly in the humid Transition, extending from San Francisco to Carmel, with the darkest specimens occurring in the Half Moon Bay region. I have 141 specimens from various coastal localities taken every month of the year and reared from numerous host plants listed under "Biology" below.

Discussion. This species has been known in the past as the European *acanthodactyla* (Hübner), but Fletcher (1940) was able to separate it from the European species. The writer has found it to be a subspecies in the *pica* complex and has shown it to be more closely related to the European *punctidactyla* (Haworth).

The differences between the populations at Half Moon Bay and Fort Bragg are very interesting even though they are both coastal localities. At Half Moon Bay of all the specimens observed only 1.4 per cent were of the gray type as in *marina*, but at Fort Bragg the situation is just reversed with only 0.8 per cent of the population brown, and the rest gray.

Biology. The larval food plants of *crataea*, which have been found along the coast of California where it occurs, are as follows: *Antirrhinum* sp. (cultivated snapdragon); *Castilleja latifolia* (seaside painted cup); *Mimulus guttatus* (common monkey flower); *Pelargonium* sp. (geranium); *Scrophularia californica* (California bee plant); *Stachys bullata*.

The most preferred food plants are *Scrophularia californica* and *Castilleja latifolia*.

Description of the immature stages. The egg is ovate to elongate-ovate, a glossy, pale yellowish in color, and in size ranges from 0.31 mm. to 0.33 mm. wide and from 0.48 to 0.53 mm. long. Under high magnification the egg shows a finely reticulated surface. Eggs are laid singly, usually on the horizontal axis in relation to the leaf surface, but can be laid on end.

The larva molts three times, thus having four instars.

The first instar larva is pale yellowish, is 1.1 mm. long and 0.18 mm. wide, with the head dark brown and the shield and anal plate light brown. The light-colored setae arise from pale brown setigerous tubercles. The true legs are pale brown, but the prolegs are concolorous with the body.

The second instar larva is similar to the first in coloration and is 2.5 mm. long.

The third instar, soon after molting, is 4 mm. long, a dirty white in color (later turning to yellowish), with longitudinal reddish lines. There is a longitudinal dorsal line, a more indefinite subdorsal line, and a subspiracular reddish line. The head and cervical shield are dark brown to black. The true legs and anal proleg are darker than the body, and the prolegs are unicolorous with the underside of the body.

The fourth instar larva at molting is 7 mm. long, later attaining a length of about 10 mm., and has two chief color forms, a green form with a dorsal

longitudinal reddish line and a reddish form with longitudinal reddish lines. The head is green with darker blotches and ocelli ring. The primary setae are white, long, certain ones slightly swollen apically, and arise from inconspicuous tubercles. The body is covered with conspicuous secondary setae.

TABLE 5
DURATION OF STAGES OF *Platyptilia pica crataea* FLETCHER NEW COMB.
AT LABORATORY TEMPERATURES*

Date hatched	First molt	Second molt	Third molt	Prepupal	Pupated	Adult emerged
Sept. 12, 1937.....	Sept. 22	Sept. 26	Oct. 1	Oct. 7	Oct. 8	Oct. 19, 1937
Sept. 26, 1937.....	Oct. 1	Oct. 4	Oct. 16	Oct. 18	Oct. 19	Nov. 1, 1937
Sept. 26, 1937.....	Sept. 30	Oct. 6	Oct. 10	.....	Oct. 18	Nov. 1, 1937
Nov. 26, 1937.....	Dec. 4	Dec. 10	Dec. 17	Dec. 28	Dec. 29	Jan. 30, 1938
Nov. 26, 1937.....	Dec. 4	Dec. 10	Dec. 17	Dec. 29	Dec. 31	Jan. 26, 1938
Nov. 26, 1937.....	Dec. 5	Dec. 11	Dec. 18	Dec. 29	Dec. 31	Jan. 26, 1938
Feb. 16, 1938.....	Feb. 23	Mar. 1	Mar. 6	Mar. 11	Mar. 20	Apr. 14, 1938
Feb. 21, 1938.....	Feb. 28	Mar. 6	Mar. 12	Mar. 25	Mar. 26	Apr. 17, 1938
Mar. 13, 1938.....	Mar. 25	Apr. 2	Apr. 9	Apr. 16	Apr. 18	May 3, 1938
Mar. 15, 1938.....	Apr. 4	Apr. 8	Apr. 15	Apr. 18	Apr. 20	May 6, 1938
Mar. 11, 1938.....	Mar. 25	Apr. 8	Apr. 15	Apr. 18	Apr. 20	May 3, 1938

* The duration of stages from the hatching of the egg to emergence of the adult for these rearings varied from 36 to 65 days, with an average of 51.3 days.

TABLE 6
DURATION OF STAGES OF *Platyptilia pica crataea* FLETCHER NEW COMB.
AT OUTSIDE TEMPERATURES*

Date hatched	First molt	Second molt	Third molt	Prepupal	Pupated	Adult emerged
Mar. 11, 1938.....	Mar. 27	Apr. 7	Apr. 18	.....	Apr. 30	May 21, 1938
Mar. 15, 1938.....	Mar. 27	Apr. 7	Apr. 18	Apr. 30	May 16	May 23, 1938
Feb. 16, 1938.....	Feb. 26	Mar. 6	Mar. 25	Apr. 7	Apr. 9	May 5, 1938

* The duration of stages from the hatching of the egg to emergence of the adult for these rearings, varied from 68 to 78 days, with an average of 72.3 days.

which are stout, swollen apically and are darker and larger along the dorsal side. The true legs have the basal segments darker than the body, whereas the stalk-like prolegs are concolorous with the body. The prolegs have 9 crochets in an outer semicircle. Over the entire integument are characteristic pointed spicules.

The pupa is 10 mm. long, angulate, varying in color from almost a uniform green to a reddish brown. The usual color is a reddish brown with some greenish background and two darker oblique bands, one extending anteriorly from the dorsal arms and the other extending from the next segment anteriorly. The abdomen has a dorsal, darker, longitudinal line, often two subdorsal, rather indefinite, wavy, lines, and a subspiracular darker line. The mesothorax has two ridges which converge posteriorly to form a crest, and the separate ridges extend posteriorly to the third abdominal segment where they

end in the pair of characteristic flattened, acutely pointed, arm-like processes. The fourth to eighth abdominal segments have a pair of projecting processes from the dorsum. The cremasteric end is grooved above and has two areas for attachment.

Life history and habits. The duration of the stages at laboratory and outside temperatures were determined during 1937-1938 at Half Moon Bay. In

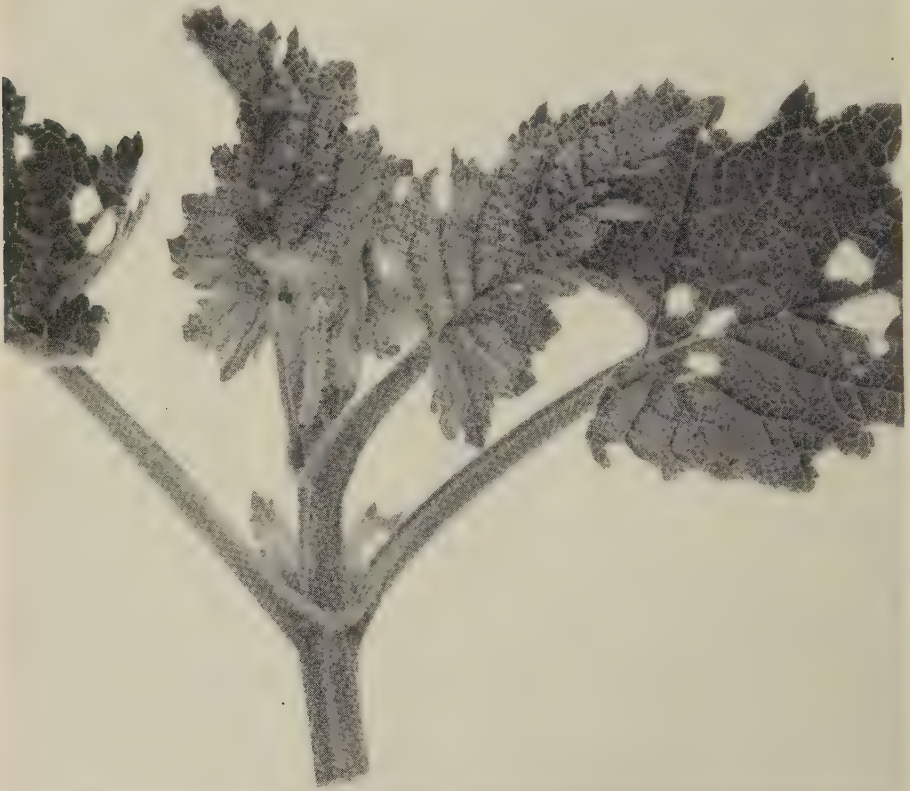


Fig. 6. Mature larva and damage of *Platyptilia pica crataeca* Fletcher, new comb., to leaves of *Scrophularia californica* at Half Moon Bay, California, March 10, 1938 ($\times 1\frac{1}{2}$).

these rearings, larvae upon emerging were placed on *Scrophularia* foliage in Stender dishes, with white blotting paper used to prevent the foliage from drying out and were kept either in the laboratory at Half Moon Bay or at outside Half Moon Bay temperatures. New foliage was added as often as was necessary.

Isolated pairs of moths, during 1938, laid from 118 to 182 eggs when placed in battery jars with foliage and fed a 10 per cent solution of sucrose. The duration of the egg stage during May, 1938, at Half Moon Bay, was 8 days at laboratory temperatures and varied from 11 to 14 days at outside temperatures. The rearings are given in tables 5 and 6.

The larvae of *crataea* are for the most part external feeders. Upon emerging from the eggs, which are laid on the undersides of the leaves or flower parts of the plants, they seek out the tender, interfolded, terminal leaves which they web together, and feed under the protection of their silken coverings. The larvae may also be internal borers, as when feeding inside the green seed pods of *Antirrhinum*. A mature larva feeding on the terminal of a plant of *Scrophularia californica* is shown in figure 6.

Pupation occurs nakedly on any part of the plant, where the pupae hang suspended from the posterior end.

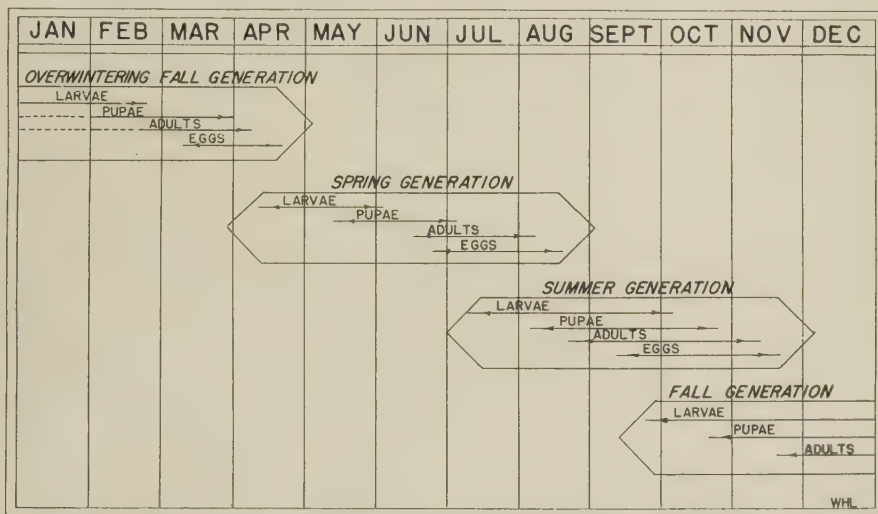


Fig. 7. The seasonal cycle of *Platyptilia pica crataea* Fletcher, new comb., at Half Moon Bay, California, on *Scrophularia californica*, 1938. (The duration of the different stages is the total period during which a stage was found, and not the duration of an average individual.)

The adults of *crataea* are rather weak fliers, and are active during dusk and at night but can be flushed from the vicinity of the larval food plants during the day. In mating the male is usually suspended in the air from the female, as is found in *carduidactyla*.

Seasonal cycle. During 1938 at Half Moon Bay the seasonal cycle was studied in large cages under outside temperatures. These results indicated that four generations a year could occur, but that part of the fall generation overwinters, so that there are only three complete generations a year. The generations shown in the seasonal cycle in figure 7 portray the total duration of the different stages and not the duration of an average cycle for an individual during the generation.

Natural enemies. A braconid parasite, *Apanteles insignis* Muesebeck, was first found parasitizing larvae of this moth at Half Moon Bay on November 28, 1937. It is found more commonly during November and December but has not been observed to be as effective in the Half Moon Bay area as in other localities where it occurs.

Crossbreeding Experiments in the *Platyptilia pica* Complex

During 1939, in a preliminary crossbreeding experiment, it was found that adults from Prairie Creek, Humboldt County, reared from *Stachys* would cross with adults from Half Moon Bay, reared from *Scrophularia californica*. The two forms are now known as *calisequoiae* and *crataea*, and have distinct color patterns. Only one adult from these cross-mating experiments was obtained and it was intermediate in color pattern between the two forms.

TABLE 7
CROSSBREEDING EXPERIMENTS IN THE *Platyptilia pica* COMPLEX—1940

Male, with host	Female, with host	Result	Nature of offspring
<i>marina</i> , <i>Castilleia latifolia</i>	<i>crataea</i> , <i>Scrophularia californica</i>	15 eggs laid; not fertile	_____
<i>crataea</i> , <i>Stachys</i>	<i>marina</i> , <i>Castilleia latifolia</i>	No eggs laid	_____
<i>marina</i> , <i>Castilleia latifolia</i>	<i>calisequoiae</i> , <i>Stachys</i> , sp.	41 eggs laid, fertile; no adults reared	_____
<i>crataea</i> , <i>Scrophularia californica</i>	<i>marina</i> , <i>Mimulus guttatus</i>	75 eggs laid, not fertile	_____
<i>calisequoiae</i> , <i>Stachys</i> sp.	<i>crataea</i> , <i>Mimulus guttatus</i>	Mating observed; 1 egg, fertile	One female reared; typical <i>crataea</i>
<i>marina</i> , <i>Mimulus guttatus</i>	<i>calisequoiae</i> , <i>Stachys</i> sp.	No eggs laid	_____
<i>marina</i> , <i>Mimulus guttatus</i>	<i>crataea</i> , <i>Mimulus guttatus</i>	Fertile eggs; 1 male, 3 females successfully reared	*Intermediate between <i>marina</i> and <i>crataea</i> ; coloration brown
<i>marina</i> , <i>Castilleia latifolia</i>	<i>crataea</i> , <i>Stachys</i> sp.	No eggs laid	_____

* An F₂ attempt was unsuccessful.

The preliminary work suggested some crossbreeding experiments, which were conducted during 1940. It was difficult to obtain crossbreeding between the different subspecies, but a few crosses were successfully made. Although the ability of certain of these forms to cross should not, perhaps, be considered as absolute evidence of the presence of subspecies, it does add a link to the chain of facts determining the present interpretation of the complex.

The results of the 1940 crossbreeding experiments are shown in table 7. Mating was not observed in all the crosses.

Several interesting observations were made during the experiments. Two males and a female of *calisequoiae* from Hiouche State Redwood Park, Del Norte County, were placed in a battery jar on July 8, 1940, with a 10 per cent sucrose solution and foliage of *Stachys*. No eggs were ever laid, which is an indication of the difficulty involved in crossing even "pure" forms, but the female lived until May 5, 1941, a total period of some eleven months. During this period the female did not show much activity and never did mate or lay eggs. The battery jar was kept at outside temperatures at Berkeley and

shielded from strong sunlight. Another female emerged from *Stachys* from Hiouchi State Redwood Park on July 21, 1940, and lived until December 1, 1940, without depositing any eggs.

It was observed in handling the different subspecies that the adults from Hiouchi Redwood State Park were of a very nervous temperament; for example, they would quickly fly out or attempt to escape at the least provocation. The Half Moon Bay *crataea*, on the other hand, was very sedentary and could be easily handled in captivity.

Platyptilia grandis (Walsingham)

(Plate 8, c; plate 15, d)

grandis Walsingham, 1880, Pter. Calif. and Ore., p. 6-7, pl. I, fig. 5 (*Platyptilus*); Fernald, 1891, Smith's List Lep. N.A., p. 87; Fernald, 1898, Pter. N.A., p. 30; Fernald, 1902, (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443 (no. 4948); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Meyrick, 1910, Gen. Insec. fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat. pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5882); Barnes and Lindsey, 1921, Pter. of Amer., p. 335-336, pl. XLIV, fig. 6; McDunnough, 1939, Check List of Lep., part II:37 (no. 6487).

Female. Primaries warm buff (Ridgway, 1912, pl. XV), except for black spot in cell at one third from base, a darker triangular mark at base of cleft extending to the costal margin, darker scales along costal margin, and the darker scales in fringes of termen and inner margin. *Head* with palpi moderate, second segment with a tuft of scales which are brown-tipped on the sides of the palpi, but are uniform buff above; frontal tuft very short, reaching only to the center of the second palpal segment; antennae buff-brown above with alternate black and white scales. *Thorax* evenly pale buff. *Primaries* buff with a patch of black scales in the cell one third distant from base, and a somewhat indefinite triangular mark of light brown scales in the usual position at the base of the cleft; triangular mark shows a darker basal patch of scales just opposite base of cleft; costal margin with a row of scattered light to dark brown scales, interrupted just beyond cleft, but extending further along margin to the outer white line of first lobe; both lobes crossed by a transverse outer pale buff line; first lobe with the bases of the fringes dark brown, and posterior margin with a few scattered dark scales in white fringe; second lobe with fringes dark brown at bases, and a few scattered dark scales along anterior margin; a patch of dark scales near inner margin at one quarter from base and more scattered buff-brown scales at one half; inner margin with a few scattered scales in fringe to one third from base, and a somewhat indefinite patch of black scales in the white ciliary fringe at two thirds from base. *Secondaries* a uniform light brown, slightly darker than primaries; fringes pale brown with paler bases; third lobe buff along inner margin with a few buff scales in the fringe. *Abdomen* barely longer than the length of the hind tibiae; color buff with sublateral and lateral tufts of black scales at posterior margins of the segments. *Legs* in general buff with a few brown scales; tibiae of forelegs with a dark brown longitudinal streak above, expanding at the distal tuft; first tarsal segment approximately one quarter of the total length of the leg; middle legs with the distal spurs of the tibiae with the inner spine slightly longer, and inwardly the distal portions of the

tibiae have a dark marking; hind legs with first pair of spurs of tibiae arising from just beyond the center, and the inner spines of both pairs of spurs are slightly longer; distally the tibiae show darker scales from a lateral view.

Expanse. 36 mm.

Male. No specimens which are definitely this species have been examined.

Female genitalia. Ovipositor lobes wide, with numerous long setae. Anterior apophyses stout. Posterior apophyses moderately produced, slender distally. Genital plate produced medially into a rounded plate, with two lobe-like projections above. Ostium on right side, very wide; basal portion of ductus bursae (copulatory pouch) is wide; ductus bursae distally a slender tube, but sclerotized a considerable distance. Bursa copulatrix a large elongated sac with signa well developed and covered by tooth-like projections.

Types. In the British Museum.

Material examined. One female from Shasta Retreat, Siskiyou County, California, collected August 16–23 (J. McDunnough, collector?). This specimen was compared with a paratype in the Fernald collection by A. W. Lindsey, November 9, 1920 (figured by Barnes and Lindsey, 1921, plate XLIV, fig. 6) and was borrowed for study through Dr. J. F. Gates Clarke of the U. S. National Museum. Perhaps the female paratype is in the U. S. National Museum but it is not given in a list supplied by Dr. Clarke, although two males, "Cal.," no date and no collector, are listed, one of which may be this specimen.

Distribution. This species is known only from Siskiyou County, California, in the vicinity of Mt. Shasta. Walsingham (1880) collected his three types on McLeod Creek, near Mount Shasta, California, in late August, 1871.

Dr. McDunnough has supplied me with a male from Wyoming which he sent as being close to *grandis*, but its simple harpes examined *in situ* place it in a different group.

To date the writer has been unable to locate this moth in the Mount Shasta region.

Biology. The host plant of *grandis* is not known but a study of the female genitalia would place it in a group which feeds on members of the Scrophulariaceae, or a related family of plants.

Platyptilia immaculata McDunnough

(Figure 8)

immaculata McDunnough, 1939, Can. Ent., 71:112.

This species has not been seen by me and so I quote McDunnough's description as follows: "Palpi projecting well beyond front; second joint rough scaled apically, the scales concealing somewhat the base of the very slender third joint; pale ochreous, tinged faintly with fuscous at apex of second joint. Front and head pale ochreous with well-developed and slightly bifid frontal tuft. Antennae simple, whitish. Thorax creamy white, concolorous with primaries. Abdomen pale ochreous, posterior segments with traces of smoky dorsal and subdorsal lines and slight lateral tuftings which are tipped with fuscous. Legs whitish, the first two pairs deep smoky on inner sides. Primaries light creamy white, tinged with smoky along costa from base

to cleft; a very faint smoky dot below base of cleft on second lobe. Fringes of outer margin of lobes pale, with a minute blackish dot below apex of wing and larger blackish patches at lower angle of first lobe and upper angle of second one; within the cleft the fringes are pale with those of the first lobe tinged in outer half with smoky; at inner angle of second lobe traces of a faint smoky shade; fringes of inner margin white in basal half and smoky in outer portion. Secondaries pale brownish. Fringes distinctly whitish basally and light smoky in outer half; third lobe without dark scale-tufts. Expanse 27 mm."

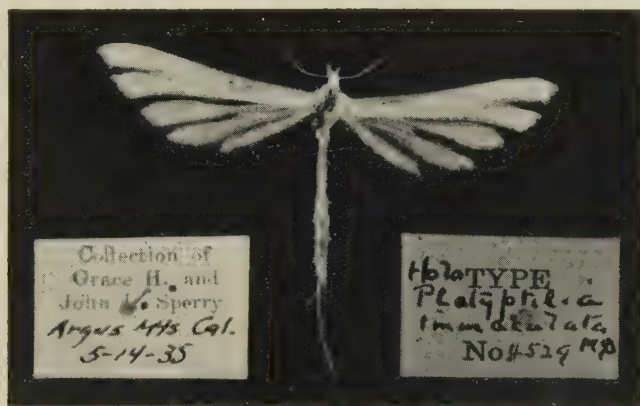


Fig. 8. Adult of *Platyptilia immaculata* McDunnough ($\times 2$). (Holotype, Canadian National Museum.)

Types. The unique male holotype is deposited in the Canadian National Collection, Ottawa (No. 4529).

Distribution. This species is only known from the type locality, the Argus Mountains, California, where it was taken by Grace H. and John L. Sperry on May 14, 1935.

Discussion. Dr. McDunnough has kindly sent a photograph of the type of *immaculata* which is shown in figure 8. Apparently a slide of the genitalia was not made, but McDunnough states that they are of the same type as *carolina* Kft. In the bifid frontal tuft this species apparently agrees with *bifida* Lange, *edwardsii* Fish, and *baueri* Lange.

Biology. The larval food plant of this species is not known.

Platyptilia baueri Lange, new species

(Plate 8, a; plate 15, e)

Female. Closest to *edwardsii* Fish (plate 8, b), but with the lobes of the primaries narrower, the outer subterminal white line almost absent, and the bases of the fringes of the termen not interrupted with patches of white scales. *Head* with palpi distinctly surpassing front; first segment with white scales below and above; second segment brown with scattered white scales, especially above where they project up and slightly over the third segment; third segment brown, with white scales above and on apex; frontal tuft rough

scaled, moderate, subtruncate, slightly bifid at center; a tuft of white-tipped scales between antennae; antennae dark brown, dotted with white scales basally and on undersides at base with yellowish-white scales. *Thorax* buff-brown with grayish cast and lighter behind. *Primaries* a brownish gray with fuscous shadings; usual triangular mark black, distinct, outlined on its outer side by a lighter shade which extends to costa; a group of black scales one fifth from base of wing on lower half followed by a fuscous area to first scale tuft along inner margin; a dark spot two fifths from base below radius; a light buff-brown area with grayish cast extends from the basal dark spots, inside the costa, around the triangle and upwards in a thin line to the costa; first lobe paler at base, then uniform grayish brown to the costa except for a wavy indistinct subterminal line. Second lobe as first with transverse line slightly indicated above; apex moderately produced; termen of second lobe slightly peaked near center; fringes with bases uniformly dark, with cilia white except grayish on basal half of second lobe; cleft with fringe grayish white with dark tufts at outer angles; inner margin with cilia white with grayish tips, and two tufts of black scales; undersurfaces with a dark dot at base of cleft, a light spot on costa and transverse white line faintly indicated. *Secondaries* uniform grayish brown with fringes slightly lighter on anterior margin of first lobe and the bases of lobes two and three; bases of cilia darker on outer margin of first lobe; third lobe with a tuft of dark scales near apex and a few dark scales near base; bases of cilia white before and after scale tuft. *Abdomen* with first segments buff-white; rough scaled, with indication of a subdorsal dark line on each side followed by a lighter band and darker underneath. *Legs* in general uniform brownish gray; forelegs with femora dark brown; tibiae white striped on inner side, with a tuft of scales distally, tarsi uniform brownish gray; middle legs uniform brown with a pair of long spines at apex; hind legs with tibiae lighter proximally; spurs long and slender, first pair with inner spine longer; tarsal segments slightly lighter.

Expanse. 26–27 mm.

Female genitalia. Of the same type as *grandis* Walsingham. Ovipositor lobes broad, with numerous spines. Anterior apophyses narrowed distally. Posterior apophyses moderately produced, slender. Genital plate produced anteriorly, slightly grooved at center. Ostium on right side, very large. Basal part of ductus bursae (copulatory tube) wide, enlarged; distally the ductus bursae is narrowed. Bursa copulatrix an elongated sac; signa well developed with two rows of tooth-like projections.

Types. *Holotype*, female, Lucas Valley, Marin County, California, June 3, 1937, collected by William Bauer. *Paratype*, female, same locality and collector, June 10, 1937 (slightly damaged).

Holotype to be deposited in the collection of the California Academy of Sciences, San Francisco; paratype, female, in the Lange collection.

Discussion. This species is closely related to *edwardsii* Fish, differing in the narrower primaries, the reduced subterminal white line, the uniform dark bases to the fringes of the outer margin, and the less apparent bifid nature of the frontal tuft. The female genitalia of *edwardsii* differ from *baueri* in the deep grooving of the median lobe of the genital plate, and the more elongate copulatory pouch (base of ductus bursae).

Platyptilia albiciliata albiciliata (Walsingham)

(Plate 9, a; plate 13, n; plate 16, a)

albiciliatus Walsingham, 1880, Pter. Calif. Ore., p. 17-18, pl. I, fig. 13 (*Platyptilus*).
albiciliata, Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4557); Fernald, 1898, Pter. N. A., p. 32, pl. IX, figs. 6, 7, 8; Fernald, 1902 (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443 (no. 4953); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Meyrick, 1910, Gen. Insec. fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat. pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5884); Barnes and Lindsey, 1921, Pter. of Amer., p. 336-37, pl. XLIII, fig. 10, probably *albiciliata canadensis* McDunnough, pl. L, fig. 15u; McDunnough, 1939, Check List of Lep., part II:37 (no. 6491).

Male. A uniform cinnamon to Mikado brown (Ridgway, 1912, plate XXIX) species, often with a grayish cast, with whitish cilia and no scale tuft on third feather of secondaries; frontal tuft short, rough scaled. *Head* light to dark brown with some buff and white scales, rough scaled, with tuft of scales between antennae; palpi ascending, surpassing frontal tuft; brown with white scaling below and above in first segment, below second segment and the tip of third segment; second segment with scales produced apically reaching below to tip of third segment; frontal tuft short, subtruncate, rough scaled, dark to light brown with a few lighter scales; antennae brown, with white scales basally, and underside of scale lighter. *Thorax* light grayish brown, in some specimens lighter behind. *Primaries* a uniform cinnamon to Mikado brown, in some specimens darker along costa and mottled with patches of lighter scales; in certain specimens a dark spot in cell, and the triangular mark faintly indicated, another spot before cleft; scales uniform cinnamon or a mixture of cinnamon, dark brown, gray and white; in some specimens a basal cinnamon area, the rest irrorated with gray and dark brown scales; termen of first lobe little produced at apex, almost straight, termen of second lobe slightly rounded; fringe of termen with dark brown bases, apices white to grayish white; fringes of inner margin grayish with a few whitish scales and scattered dark scales about the center of inner margin; fringe of cleft, grayish brown; a dark tuft of scales at tornus; undersurfaces brown, lighter apically. *Secondaries* a uniform cinnamon brown to grayish brown with fringes lighter at bases; a few scattered dark scales along inner margin of third lobe or absent entirely. *Abdomen* a uniform cinnamon with a few fuscous and white scales. *Legs* in general uniformly colored, no banded effect; fore- and middle legs with a longitudinal brown stripe which continues down tarsal segments above; hind legs with tibiae white, becoming irrorated with grayish-brown scales distally; tarsal segments white above, first pair of spurs long, slender.

Expanse. 19-22 mm.

Female. Essentially as male.

Male genitalia. The broadly, almost straight-margined, spatulate apex to the uncus is characteristic of this species. Harpes with a well-developed hook-like cucullus; sacculus well developed, not greatly peaked at center. Uncus long, broadly spatulate at tip, with a blunt point, set with numerous small setae; fastens below to a well-developed triangular basal plate (juxta). Saccus prominent, produced apically into a point, basally grooved one fifth of length.

Female genitalia. Ovipositor lobes moderate. Anterior apophyses slender, long, slightly inflated at apices. Posterior apophyses moderately developed, slender. Genital plate extends anteriorly in a median position and has a basal pair of lobes, a median pair, the right one of which extends into the chitinized copulatory tube, and a pair of roughened lobes above. Ostium arises on right side. Copulatory tube (base of ductus bursae) is well developed, wide at base and then narrowed slightly. Rest of ductus bursae a narrow tube, and is sclerotized for a short distance. Bursa is an elongated sac, with signa well developed, thorn-like, with rows of evident tooth-like projections.

Types. In the British Museum, and one male "type," which is probably one of Walsingham's cotypes, in the United States National Museum.

Material examined. One "type," male? (body missing) with the label in Lord Walsingham's writing, borrowed from the United States National Museum through Dr. J. F. G. Clarke. Five specimens collected two miles south of Mendocino, California, June 24, 1940, resting on *Castilleia latifolia* growing on an ocean bluff. Two specimens reared from larvae collected at Fort Bragg, Mendocino County, June 20, 1941, the adults emerging July 26, 1940. One specimen collected flying in a field near the ocean on August 31, 1941, at Little River, Mendocino County, California.

Distribution. Typical specimens have been found only along the coast in Mendocino County, California, although other forms extend into British Columbia and east to Idaho and Montana.

Discussion. The writer is designating as the typical species unicolor, cinnamon to brown individuals, which have the triangle absent from the primaries, and which have a distinctive grayish cast to the primaries, not found in specimens farther south along the coast of California.

The specimens referred to as this species by Barnes and Lindsey (1921) from British Columbia, having a well-marked triangle and more of a grayish cast to the wings, are undoubtedly what McDunnough described as the variety *canadensis*.

The writer is placing Walsingham's *orthocarpi* as a race or subspecies of this insect, which is discussed under that species.

Specimens which Barnes and Lindsey (1921) could not definitely place as *orthocarpi* from certain localities are undoubtedly undescribed varieties of this insect. The specimen of *fragilis* figured by these authors has been examined and found to belong to this species (plate XLIII, fig. 5) and a specimen from the same locality (Deer Park Springs, Lake Tahoe, California) was determined by Meyrick as *fragilis*. *Fragilis* has very distinctive genitalic features which can be referred to under this species.

The author has a female from Maple Creek, Humboldt County, which may represent an undescribed race of *albiciliata* when further material is collected from the same locality.

Walsingham's cotype is the lightest and most uniformly colored specimen I have examined.

Biology. The larval host plant is *Castilleia latifolia* (seaside painted cup). Larvae were collected on June 24, 1940, at the type locality, and two adults were reared. Larvae were also collected at Fort Bragg, California, which is not far from the type locality.

On June 24, 1940, on an ocean bluff approximately two miles south of Fort Bragg, the writer found five specimens of this species resting on *Castilleia*. Further observation showed eggs laid on the outer flower bracts and mature larvae boring inside the green seed pods. The species was not common. Apparently the grazing of livestock on the ocean bluffs in this vicinity, combined with cultivation, has practically exterminated *Castilleia* in this region, which may account for the difficulty in finding large populations of this insect. The adults, when flushed, flew only several feet, coming to rest on the grass.

A description of the known immature stages is presented under the race *rubricans*, as little difference in the stages was found.

Platyptilia albiciliata rubricans Lange, new subspecies

(Plate 1, i; plate 2, b; plate 3, a; plate 9, b)

albiciliata, Lange, 1939, South. Calif. Acad. Sci. Bul., 38(1):24-25 (biol.).

This name is proposed for a population which has been found in San Mateo and Monterey counties of coastal California, characterized by the deeper reddish-brown color of the wings and the tendency toward the formation of the usual triangular mark of the primaries, especially in the females.

Male. *Antennae* distinctly banded with white and dark brown at base. *Primaries* with triangle not distinctly separated, but extending as a darker elongated, triangular area reaching costa about one third from base; the subterminal lighter line is faintly indicated on first lobe; second lobe slightly peaked at center; inner margin with scattered dark scales at center, well indicated. *Secondaries* with bases of cilia distinctly white on lobes 2 and 3; scattered dark scales along inner margin of third lobe well developed.

Expanse. 15-22 mm.

Female. As male, except the dark brown triangular mark well defined, irrorated along costa with a few whitish scales; a light spot on costa beyond triangle; subterminal white line faintly indicated on first lobe.

Genitalia. As in the typical insect.

Types. *Holotype*, male, collected as larva on *Castilleia latifolia*, on June 22, 1941, at Point Lobos, Monterey County, California, the adult emerging July 3, 1941. *Allotype*, female, same data, the adult emerging July 12.

Paratypes, 3 females with same data as holotype, 12 males collected near Sharp Park, San Mateo County, California, reared from *Castilleia latifolia*, with emergence on the following dates: April 17, 1938, 1; April 19, 1938, 1; June 18, 1939, 1; June 21, 1939, 1; July 13, 1939, 1; July 17, 1939, 2; July 19, 1939, 1; July 24, 1939, 1; August 2, 1940, 1; and June 10, 1940, 2; 17 females, all from Sharp Park, reared from *Castilleia latifolia* with the following emergence dates: May 29, 1939, 1; June 8, 1939, 5; June 21, 1939, 1; July 9, 1939, 1; July 11, 1939, 2; July 17, 1939, 1; July 24, 1939, 1; June 16, 1940, 1; July 1, 1940, 2; July 14, 1940, 1; and May 15, 1941, 1.

Discussion. An analysis of the specimens on hand, showing the tendency for the formation of a triangular mark in this race is shown in the following percentages: in the females, 76.6 per cent show an indication of a triangle, and 26.6 per cent have the triangle well developed; in the males, 76.4 per cent show an indication of a triangle, and 5.8 per cent have it well developed.

The specimens from Point Lobos show a greater tendency toward the formation of the triangle than do the San Mateo County individuals; but additional collecting further south is needed to properly evaluate the significance of this variation.

This race is close to the race *canadensis* McDunnough in the presence of a triangle, but *canadensis* is more of a dull, uniform, grayish brown with the markings less emphasized.

Biology. The food plant of the larvae is *Castilleja latifolia*, a perennial species in the family Scrophulariaceae, growing on ocean bluffs along the coast of California. This plant was observed to remain green throughout the year in certain localities, thus allowing a continuous development of the moth.

Description of the immature stages. The egg is glossy, yellowish, elongate-elliptical to ovate in shape and can be laid on the horizontal or vertical axis in relation to the leaf surface. The length varies from 0.48 to 0.83 mm. and the width from 0.26 to 0.31 mm. Some eggs are slightly flattened on one end, and under magnification there appear longitudinal corrugations and shallow depressions which cover the surface of the eggs. Eggs are usually laid on the undersides of the outer flower bracts or leaves, but can be laid on the upper surfaces of the leaves, bracts, or on the stems.

The first instar larva is 1.32 mm. long (extended), with the greatest width 0.176 mm., and the body tapers to both ends. In general, the larva is green with a dark brown head and light brown cervical shield and anal plate. The primary setae are darker than the body and arise from dark tubercles. The legs are all concolorous with the body. Larvae in the first instar move rather rapidly and they can either become leaf miners or can bore directly into the small developing ovaries or other tender parts. The premolt to the second instar has been observed inside the green pods.

The second instar larva (following the first molt) is approximately 1.76 mm. long when extended, with a width at the first abdominal segment of 0.31 mm. The color is yellowish green with the head, cervical shield and anal plate brown. The setae are moderately long and arise from brown tubercles. Second instar larvae are active, boring inside the stems or seed pods, or feeding on the bracts of the flower heads.

The third instar larva attains a length of 6 mm. with the greatest width of 1.01 mm. at the center of the body. The body tapers from the center to both ends. In color the larva is greenish with the head dark brown and the cervical shield and anal plate light brown. The true legs are slightly darker than the body. The prolegs are only moderately developed and are concolorous with the underside of the body. The primary setae are moderately developed, light colored and arise from dark, conical tubercles. A few secondary setae with swollen tips are found, but do not cover the body as in the fourth instar larva. The surface of the body is densely covered by small dark brown spicules.

The fourth instar larva attains a length of 12 mm. with the body tapering posteriorly from the second thoracic segment. In color the larva is pale green with a darker, median, longitudinal line and two subdorsal, undulatory, lighter lines. The head is pale green, sometimes with darker blotches, and with six ocelli in a dark brown field; the mandibles are deeply four-toothed with one smaller tooth. The green cervical shield is well developed, and is

armed with long setae which project over the head. The primary setae are long, often slightly swollen apically, and inconspicuous, arising from conical tubercles. Covering the body are numerous secondary setae which are white, short, thick set, and swollen apically. The skin spicules covering the body are subtriangular raised processes which can best be seen under magnification. All the legs are concolorous with the body. The prolegs are stalk-like with a ring of crochets, 8 to 9 in number, arranged in a uniordinal semicircle. The anal proleg is heavy set, and has 10 crochets. The spiracles are slightly raised, and brown ringed.

Fourth instar larvae are found chiefly as borers inside the green seeds, although they can feed inside the stems or on the flower parts.

The pupa is angulate, ranges in length from 9 to 11 mm., and its greatest width is approximately 2 mm. at the mesothorax. The color is a dark reddish brown with a darker longitudinal line medially on the dorsum of abdomen, several indefinite whitish lines on abdomen and two lighter ridges on the thorax. The head has the front slightly produced and the bases of the antennae widen above the eyes. The mesothorax has two roughened ridges which approach each other posteriorly to form a crest and extend noticeably to the third abdominal segment. The wing cases show the slightly lighter and raised veins. The markings on the abdomen vary, but usually in addition to the dark, longitudinal, median line there is a broad, indefinite, subdorsal line and a subspiracular dark line which are outlined by at least three thin, lighter lines. On the abdominal segments are transverse corrugations which are very noticeable. The cremasteric end is grooved above, has two dorsal ridges and, ventrally, two areas of hooked setae for attachment. Usually the pupa is attached nakedly, hanging head downward from the leaves or stems of the plants.

Life history and habits. As for the typical species, *rubricans* has the perennial *Castilleja latifolia* as the larval food plant. Larvae were first found April 17, 1938, at Sharp Park, along with larvae of *Platyptilia pica crataea* Fletcher, and a note was published (Lange, 1939) giving a description of the mature larva and pupa.

The small larvae can be leaf miners or can bore directly into the flower structures or green seed pods. As the larvae develop they seek out the green seed pods. The pupae are attached nakedly to any part of the plant, hanging head downward, or pupation can occur in the burrows inside the eaten-out portions of the plants.

Adults were found to stay close to the food plant, flying only when disturbed and then only for short distances. The peak of emergence is apparently from the middle of May to the end of June, although adults have also been taken in April, July and August.

The seasonal cycle has not been intensively studied, but the observations which have been made indicate that there are from 2 to 3 generations a year, with the stages overlapping, as is found in other plume moths of this genus along the coastal areas of California. The plants begin to dry up in June, but there is always some green foliage present.

Natural enemies. No parasites or predators have been found during the studies of this moth.

Platyptilia lutescens Lange, new species

(Plate 9, d; plate 13, o; plate 16, c)

Male. In general, appearance as *fragilis* Walsingham, but closer morphologically to *albiciliata* Walsingham; primaries a satiny, light ochraceous buff (Ridgway, 1912, plate XV), with the triangle strongly indicated and the subterminal white line indicated only as a broad, pale, terminal area through both lobes. *Head* buff; palpi evident, surpassing frontal tuft, buff with a few darker scales, second segment with enlarged tuft of scales apically which projects under and above the third segment; frontal tuft short, slightly rounded, with smooth scaling; antennae dark brown, with a few white scales basally, and scape buff. *Thorax* ochraceous buff to buff-brown. *Primaries* light ochraceous buff, with a gray cast before the triangle; a dark dot in cell at approximately one third from base; usual triangular mark composed of dark brown to black scales, somewhat diluted with brown; costal margin with a few scattered dark scales, also a few scattered dark scales on basal portion of wing along cubitus vein; first lobe satiny ochraceous buff with a few black scales beyond center on costa and a few dark scales scattered indiscriminately; a rather indefinite, lighter, subterminal band is evident; and, on the right wing only, a patch of whitish scales centrally located, reaching the outer margin; second lobe as first with a very faint indication of a lighter subterminal line; outer margin of both lobes with a row of dark scales; apex appears well produced due to a tuft of dark scales; fringe grayish white with dark bases; cleft with fringe grayish white, outer angles with dark tufts; inner margin with grayish-white fringe and one noticeable dark tuft below basal point of triangle, and a few scattered scales before and toward base. *Secondaries* a light grayish brown with unicolorous fringes except for the paler bases to cilia on the posterior margin of third lobe; no scale tuft present, but a few scattered dark scales. *Abdomen* uniform buff. *Legs* in general a uniform light brown, long, slender; forelegs dark brown with a light stripe; middle legs with tibia dark brown with a longitudinal light buff stripe and the tarsal segments dark brown; hind legs with tibiae light brown, darker at apices, spurs long and slender; tarsal segments buff to light brown.

Expanse. 20–22 mm.

Female. Essentially as the male; the allotype, female, is paler than the holotype, making the hind wings appear darker.

Male genitalia. Of the size of *shastae* Walsingham, but with a broadly spatulate apex to the uncus as in *albiciliata* Walsingham. Harpes with terminal hooks, which are rounded on the ends and rather thick set; sacculus well developed, widened just beyond center. Uncus rather long with the apex broadly spatulate. Anellus lobes are two narrow plates, thickly set with small spines, produced into a slight point apically, and joined basally to the triangular basal plate. Saccus produced into a point, grooved below. Aedeagus moderate, expanded basally, and slightly enlarged distally.

Female genitalia. Ovipositor lobes elongated, narrow. Anterior apophyses rather stout. Posterior apophyses moderately produced. Genital plate produced anteriorly with two peaks below and two roughened lobes above. Ostium arises on right side. Copulatory tube an enlarged, elongated, sclerotized struc-

ture; rest of ductus bursae a narrow tube. Bursa copulatrix an elongated sac, signa well developed, with tooth-like edges.

Types. *Holotype*, male, Ivanpah Mountains, San Bernardino County, California, May 3, 1939, collected by Dr. John A. Comstock. *Allotype*, female, with same data. *Paratype*, male, with same data. Holotype and allotype to be deposited in the collection of J. A. Comstock at the Los Angeles Museum, Los Angeles, California; paratype in Lange collection.

Discussion. This species can be separated from *fragilis* Walsingham by the male and female genitalia which are described and figured. Although superficially it seems to be close to *fragilis*, its other features place it closer to *albiciliata* Walsingham and *shastae* Walsingham. The spatulate apex of the uncus would indicate closer relationship to *albiciliata*. The satiny ochraceous buff appearance of the primaries, with the absence of a definite subterminal white line, is also a useful aid in separating this species.

Platyptilia albida (Walsingham)

(Plate 10, c; plate 13, p; plate 14, a; plate 16, d)

albidus Walsingham, 1880, Pter. Calif. and Ore., p. 10-11, pl. I, fig. 8 (*Platyptilus*).

albida, Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4552); Fernald, 1898, Pter. N. A., p. 29, pl. VIII, fig. 10, 11; Fernald, 1902 (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443 (no. 4946); Meyrick, 1910, Gen. Insec. fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5879); Meyrick, 1921, The Ent., 54(703):276 (lists *shastae* Wlsm. and *fragilis* Wlsm. as syn.); McDunnough, 1939, Check List of Lep. part II:37 (no. 6494).

Male. General color brownish gray with variable white irroration; the boundaries of triangle usually not distinctly defined, and scale tuft of secondaries absent or a few scales toward end of lobe. *Head* whitish to brownish; palpi whitish to brownish with light scales below and above on first segment; second segment rough scaled, with scales practically covering third segment; third segment light tipped; frontal tuft short, subtruncate; tuft between bases of antennae rough scaled; antennae dark brown, usually banded with white scales, especially at base. *Thorax* brownish white with grayish tone, to grayish brown. *Primaries* grayish brown with variable amount of whitish irroration; triangular mark dark brown; well indicated to faintly outlined with whitish; transverse white line usually indicated through both lobes, but can be absent; costal margin sometimes giving a mottled effect due to alternate patches of lighter scales; fringe of outer margin grayish white with dark bases; fringe of cleft white to grayish white with the outer angles dark tufted; a dark tuft at anal angle of second lobe; fringe of inner margin white to grayish white with two dark scale tufts present or completely absent. *Secondaries* a uniform grayish brown, in lighter specimens noticeably darker than primaries; fringes of third lobe noticeably lighter at bases on inner margin, with a few scattered dark scales and in some specimens a small group of dark scales near apex. *Abdomen* rough scaled, whitish brown to brownish. *Legs* appear grayish white with some fuscous; forelegs grayish white with a darker stripe on tibiae often extending dorsally down tarsal segments; middle legs also striped with a pair of apical tibial spurs which are dark with a light stripe; hind legs grayish white, sometimes with scattered brown scales; first

pair of spurs long, slender, dark striped below; second pair shorter, also striped.

Expanse. 20–29 mm. (average 23 mm.).

Female. As male.

Male genitalia. Similar to *albidorsella*, but with the uncus evenly rounded apically, and the aedeagus not greatly enlarged terminally. Harpes with a hook-like cucullus; sacculus well developed. Uncus spatulate, but not as much as *albiciliata*. Anellus lobes are two plates with a terminal projection and set with numerous setae; attached basally to the triangular juxta. Aedeagus evenly enlarged terminally, not with an abrupt terminal enlargement.

Female genitalia. Ovipositor lobes well developed. Anterior apophyses moderately long, rather stout, may be slightly enlarged at ends. Posterior apophyses short, wide at base, narrowed at ends. Genital plate extends posteriorly as a median bilobed plate. Ostium on right side, rather wide. Copulatory pouch (base of ductus bursae) enlarged, the rest of the ductus bursae narrowed. Signa of bursa copulatrix well developed, with rows of tooth-like projections.

Types. In British Museum. Two "types" in U. S. National Museum collection (originally in the Fernald collection).

Material examined. Two "types" "Cal," apparently part of Walsingham's cotypes from California, 1 male, one with no body, borrowed from the U. S. National Museum through Dr. J. F. Gates Clarke; 1 male, Leavitt Meadows, Mono County, California, June 30, 1925, collected by E. H. Nast; 4 males, May 13, 1925, and 2 males, May 15, 1932, Pullman, Washington, J. F. Gates Clarke; 6 specimens reared from *Castilleja lutescens* at Pullman, Washington, March 9–20, 1934, by J. F. Gates Clarke; 1 male, Ft. Steele, British Columbia, June 23, 1922, collected by W. B. Anderson.

California distribution. Apparently *albida* is a montane species in California. Walsingham took part of his type series in Lake County, California, on June 18, 1871. The U. S. National Museum has a male and two females taken from Monachee Meadows, Tulare County, California, at an elevation of 8,000 feet, July 8–14. The San Francisco Academy of Sciences has one male from Glen Alpine Creek, El Dorado County, California, July 11, 1909, collected by F. X. Williams, and one female from Placer County, California, in September, collected by A. Koebele.

Extra-California distribution. Walsingham collected twelve specimens of his type series on the banks of the "Rouge" (Rogue?) River, in southern Oregon, May 7, 1872. The Pullman, Washington, specimens mentioned in "material examined" are the only others the writer has seen.

Discussion. The range in color in this species is apparently greater than was considered by Barnes and Lindsey (1921), some specimens appearing so close to *albidorsella* that only genitalic mounts finally settled their identity. The male genitalic differences used to separate *albida*, *albidorsella*, and *maea* are small, but seem to hold in all of the specimens examined. The uncus in *albida* is noticeably less spatulate than in *maea*, and the pointed uncus of *albidorsella* is very distinct. In *albidorsella* and *maea* the aedeagus has a terminal enlargement, which is reduced in *albida*. The "types" examined are the lightest-colored individuals I have seen, although the specimen from

Leavitt Meadows approaches them, while the Pullman, Washington, specimens are more distinctly marked with the costa mottled, and the background with more brownish irroration.

Biology. The reared specimens from Pullman, Washington, on *Castilleja lutescens*, give the only clue to the biology of this species. The attached pupal cases are similar to those of *albiciliata* and *shastae* but can be differentiated by a noticeable difference in the shape of the front. The front of *albida* is larger, has two dorsal indentations, and has the clypeus well set off. *Shastae* has a smaller front which is evenly rounded and does not have the dorsal indentations. The front of *albiciliata* is the smallest of the three, and is a rounded triangle, with no distinct separation of the clypeus.

Platyptilia shastae (Walsingham)

(Plate 3, b; plate 10, a; plate 14, h; plate 16, b)

shastae Walsingham, 1880, Pter. Calif. and Ore., p. 14-16, pl. I, fig. 11 (*Platyptilus*); Dimmock, 1882, Psyche, 3:403 (*Platyptilus*); Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4555); Fernald, 1898, Pter. N. A., p. 28; Fernald, 1902 (Dyar's List Lep.) U. S. Nat. Mus. Bul. 52:443 (no. 4943); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Meyrick, 1910, Gen. Insec. fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5877); Meyrick, 1921, The Ent., 74 (no. 703):276 (lists *shastae* Wlsm., as syn. of *albida* Wlsm. and *fragilis* Wlsm.); Barnes and Lindsey, 1921, Pter. of Amer., p. 334, pl. XLIII, fig. 7; Lindsey, 1922, Ent. News, 33:213 (Meyrick's syn. notes); McDunnough, 1927, Roy. Soc. Can. Trans., section V:179, pl. I, fig. 4; McDunnough, 1939, Check List of Lep., part II:37 (no. 6493).

Male. A small brightly marked species, appearing more like certain forms of *albiciliata* Walsingham. *Head* buff with some lighter scales; palpi slender, slightly ascending, surpassing tuft; first segment with lighter scaling above and below; second segment with enlarged tuft of hairs apically, projecting up and obscuring part of third segment, and with white scales above and below; third segment with lighter scales; frontal tuft short, subtruncate with a few lighter scales; tuft of scales between antennae; antennae dark brown, banded with white scale tufts. *Thorax* buff to whitish or grayish; tegulae lighter, composed of buff, white, and grayish scales; lighter scales behind. *Primaries* in general grayish brown; costal margin darker, with mottled effect due to patches of lighter scales, extending into the dark brown, distinct, triangular mark; scaling of primaries consisting of brown, gray, white, and fuscous scales intermingled; a dark brown spot in center at basal area and another below radius at approximately one third from base; first lobe with outer face of triangle lighter, extending to costa where a light spot appears; costal margin dark at center between the light outlining on triangle and outer pale line; outer pale line light on costa and light area extending slightly along costa; second lobe with outer line less apparent, darker toward outer margin and overlaid with whitish irroration; fringes of outer margin grayish white with black bases and slightly darker tips; fringe of second lobe in some specimens interrupted by two areas of white scales, giving a wavy appearance to margin; fringes of inner margin grayish to whitish with two dark scale tufts, one below point of triangle, another at about two thirds from base. *Secondaries* appear slightly darker than primaries, a uniform grayish brown; bases of

fringes of outer margin of first lobe with darker bases, and of costal margin of first lobe with whitish cilia; third lobe without scale tufts, but fringe darker with paler bases and a few scattered dark scales basally. *Abdomen* rough scaled, with buff to white scales and a few fuscous scales at posterior margin of some segments. *Legs* distinctly marked; forelegs with tibiae whitish with a distinctive longitudinal dark brown stripe as seen from front, and the apical tibial tuft greatly enlarged; dark stripe extending down tarsal segments; middle legs appear dark brown with a light stripe as seen from above, the spurs stout and dark striped; hind legs with basal portion of tibia whitish, with darker scales at origin of spurs and the rest of legs generally whitish to grayish brown; first pair of spurs moderately long, slender, second pair shorter and stouter; tarsal segments often darker at distal portion of segments.

Expanse. 16–21 mm.

Female. Essentially as male.

Male genitalia. Of the same type as *albida* and *albiciliata*. Harpes with hook-like cucullus. Uncus with tip evenly spatulate, not angulate as in *albiciliata*. Anellus lobes narrow plates, apically produced into a thumb-like process, basally attached to the well developed triangular juxta. Aedeagus gradually enlarged terminally with a slight narrowing toward apex, and a slight bulge at apex. The structures are closer to *albida* than any other species.

Female genitalia. Ovipositor lobes narrow. Anterior apophyses short. Posterior apophyses reduced. Genital plate bilobed with two pointed lobes above. Ostium arising from right side, wide. Copulatory pouch, a broad basal enlargement of ductus bursae; distally the ductus bursae narrows abruptly and is sclerotized for a short distance. Signa of bursa thorn-like, set with conspicuous saw-tooth projections. The female genitalia seem closer to *albiciliata* than to any other species.

Types. In the British Museum.

Material examined. California, 4; Washington, 1.

Discussion. The typical specimens are easily separated by the brighter markings and genitalic features mentioned. It is closely related to *albida* and *albiciliata*, but distinct. The pupal differences noticed are given under *albida*.

Biology. Larvae were collected on *Castilleia pinetorum* north of Shasta City on July 7, 1941, by the writer, from which four adults were reared. Eggs and larvae of a plume moth which is probably referable to this species were collected July 9, 1941, 6 miles south of McCloud, California, on *Castilleia parviflora* var., but no adults were reared, so this record remains unverified.

The host plant is a perennial and the larvae feed more or less externally on the flower heads, similar to the feeding of *albiciliata*.

Immature stages. The mature larva is from 9 to 10 mm. long, pale green in color, with a slight indication of a dorsal longitudinal reddish line, and with a mid-dorsal sublateral and subspiracular white line on each side. The body is clothed with short, white, secondary setae which are swollen apically. The head is green with indistinct dark blotches, and the ocelli are black. The primary setae are white and moderately long. All of the legs are green, and the basal portions of the prolegs appear semitranslucent. The larva appears related to *albiciliata*, but has the dorsal longitudinal reddish line only faintly indicated.

The pupa is 9 mm. long, and a reddish brown in color. The mesothorax has two dorsal ridges which converge posteriorly to form a dorsal projection and the separate ridges extend to the third abdominal segment. On the abdomen is a dorsal longitudinal line, subdorsal and lateral longitudinal white lines, and a subspiracular whitish line. The front is slightly produced anteriorly. The veins of the wing cases appear lighter in color. In general appearances the pupa is similar to *albiciliata* but the darker lateral and ventral longitudinal lines of *albiciliata* are absent or greatly reduced. Pupation occurs externally on the plants, held by two areas of attachment at the posterior end.

The adults are capable of rapid flight when aided by wind currents. The author flushed one specimen which was resting on sagebrush, in the same locality where larvae were collected, on September 6, 1941. Apparently there are several generations a year.

A pair was placed in a battery jar with a 10 per cent sucrose solution and *Castilleia* foliage on July 23, 1941, but no eggs were laid.

Platyptilia albidorsella (Walsingham)

(Plate 12, c; plate 14, d; plate 16, e)

albidorsellus Walsingham, 1880, Pter. Calif. and Ore., p. 13-14, pl. I, fig. 10 (*Platyptilus*).
albidorsella, Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4554); Fernald, 1898, Pter. N. A., p. 30, pl. VIII, fig. 5, 6, 7; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:443 (no. 4947); Meyrick, 1910, Gen. Insec., fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:14; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5875); Barnes and Lindsey, 1921, Pter. N. A., p. 334-335, pl. XLIII, fig. 9; McDunnough, 1927, Roy. Soc. Can. Trans., section V:181, pl. I, fig. 8; McDunnough, 1939, Check List of Lep., part II:37 (no. 6497).
coloradensis, Grinnell, 1908, Can. Ent., 40:321 (*ex parte*).

Male. Color essentially as browner examples of *albida*. *Head* grayish brown with scattered white scales; palpi brown with variable amount of white scaling (essentially as in *albida*); frontal tuft short, subtruncate, rough scaled; tuft of scales between antennae; antennae brown, banded with white. *Thorax* grayish brown. *Primaries* grayish brown, sometimes with fuscous markings; triangle present or absent; if triangle is absent, represented by darker spot before cleft; typical species with darker costa, widening before triangle, and with a lighter area in cell to around outer face of triangle; some specimens a uniform grayish-brown color, with the costa mottled and the wings variably irrorated with scales; fringes of outer margin grayish white with darker bases; fringe of cleft grayish white, with darker tufts at outer angles; in one specimen the cleft is outlined at the base with darker scales; fringe of inner margin with two dark tufts of scales and scattered black scales basally. *Secondaries* uniform grayish brown, with the bases of the cilia in the inner margin of third lobe lighter; a few dark scales near apex of third lobe with scattered dark scales to base, or scale tuft absent. *Abdomen* grayish brown with scattered white scales. *Legs* similar to *albida*; forelegs and middle legs with tibiae and tarsi dark striped; hind legs whitish above, darker brown below; first pair of spurs long, second pair shorter.

Expanse. 20-28 mm. (average 24 mm.).

Female. As male.

Male genitalia. Similar to *albida*, but with the uncus more pointed apically and the aedeagus with a terminal enlarged portion. The harpes as a rule are longer than in *albida* and the cucullus narrower and more attenuated.

Female genitalia. Distinct from *albida*. Genital plate wide with two lobes below, surmounted by two pointed finger-like processes above, more like in *maea*. Ostium arises on right side. Copulatory pouch a wide, subrectangular structure; ductus bursae distally becoming a narrow tube, although sclerotized practically its entire length. Signa well developed, curved, with a saw-tooth edge.

Types. In the British Museum.

Material examined. One specimen, San Diego, California, collector, Rick-secker, was compared with the type in the British Museum by E. Meyrick and borrowed from the U. S. National Museum (figured by Barnes and Lindsey in their monograph, 1921, plate XLIII, fig. 9). One female, Bouquet Canyon, Los Angeles County, California, May 20, 1939, N. Westerland, collector. Five specimens, Pullman, Washington (May), collected by J. F. Gates Clarke and C. V. Piper. One specimen, Wenatchee, Washington, May 12, 1930, collected by J. F. Gates Clarke. Seven specimens, Pine Creek, Shoshone County, Idaho, May 17, 1932, collected by W. R. Sweadner. Two specimens, Waterton Lakes, Alberta, Canada, June 19, 1923, collected by J. McDunnough.

Discussion. This species seems to occur along with *albida* in Washington and British Columbia, and specimens are difficult to separate in these localities. The genitalic features are very helpful and it was found possible to examine the uncus *in situ* for the males. Better differences are shown in the female genitalia, but these can only be observed in slide preparations. There are probably several subspecies involved in the group of specimens considered under this name. The Idaho specimens are larger, have more brown suffusion and other minor differences.

Biology. Nothing of the early stages of this insect is known. Judging from its relationship the larval food plant should be *Castilleia* or a closely related genus.

Platyptilia fragilis (Walsingham)

(Plate 9, e; plate 14, b)

fragilis Walsingham, 1880, Pter. Calif. and Ore., p. 16-17, pl. I, fig. 12 (*Platyptilus*); Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4556); Fernald, 1898, Pter. N. A., p. 28; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:443 (no. 4944); Anderson, 1904, Cat. Brit. Col. Lep., p. 50 (no. 990); Brit. Col. Ent. Soc. Check List, p. 42; Meyrick, 1910, Gen. Insec., fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:14; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5874); Meyrick, 1921, The Ent., 54 (no. 703):276 (syn.); Barnes and Lindsey, 1921, Pter. of Amer., p. 333, pl. XLIII, fig. 5 (*ex parte*) (figure var. of *albiciliata* Wlsm.); Lindsey, 1922, Ent. News, 33:211-13 (Meyrick's syn. notes); Braun, 1925, Amer. Ent. Soc. Trans., 51:184 (food plant); McDunnough, 1927, Roy. Soc. Can. Trans., section V:178-179, pl. 1, fig. 5; Braun, 1930, Can. Ent., 62:122 (biol.); McDunnough, 1939, Check List of Lep., part II:37 (no. 6496).
coloradensis, Grinnell, 1908, Can. Ent., 40:321 (*ex parte*).

Male. A small species with the primaries in general grayish brown, the black triangular mark well defined, and the outer pale line faintly indicated. *Head* buff to buff-brown; palpi long, slightly ascending, with third segment

directed slightly downwards; first segment buff with lighter scales below and above; second segment with scales projecting upward and under the third segment, the outer scales lighter in color; the third segment whitish; frontal tuft short, sometimes slightly indented at tip and rounded at outer edges; tuft of scales between antennae well developed; antennae banded with alternate patches of dark brown and white scales. *Thorax* buff to grayish brown. *Primaries* grayish brown; triangle dark brown, well defined; costal margin usually darker with white irroration; a dark spot in cell at approximately one third from base; triangle outlined on outer face with a lighter line, uniform grayish brown, except outer pale line is faintly indicated and in some specimens a few darker scales at center of costa on first lobe; a dark tuft of scales at apex and at angles of lobes at cleft and anal angle of second lobe; fringe of outer margin grayish white with darker bases and grayish tips; fringes of inner margin grayish white, with two dark scale tufts. *Secondaries* a uniform grayish brown with fringes of outer margin of first lobe slightly darker at bases; third lobe with fringe lighter at bases, scale tuft absent, with scattered dark scales at base. *Abdomen* uniform buff to brown with scattered fuscous scales at posterior margin of some segments. *Legs* not appearing distinctly marked; forelegs with a dark stripe down tibia, as seen in front, which continues down tarsal segments; middle legs also striped with the tibial spurs well developed; hind legs uniform grayish white with slightly darker patches at origin of spurs to a general fuscous suffusion from middle of tibiae to end of first tarsal segment.

Expanse. 17–25 mm.

Female. As male.

Male genitalia. The long slender uncus and greatly elongated aedeagus will readily separate this species from any other members known to our fauna. Harpes long, with well-developed hook-like cucullus; the sacculus is characteristically narrowed toward base. Uncus long, slightly expanded at tip. Anellus lobes long, narrow plates set with numerous spines and fastened basally to a triangular juxta. Saccus broadly pointed, grooved beneath. Aedeagus very long, with an expanded tip.

Female genitalia. The greatly enlarged copulatory pouch, presumably for the reception of the aedeagus, is a characteristic feature. Ovipositor lobes wide, set with numerous spines. Anterior apophyses moderately long, can be slightly swollen before tip. Posterior apophyses moderately developed, thorn-like. Genital plate bilobed; rather deeply emarginate at center with two dorsally placed cone-shaped lobes above. Ostium arises on right side, wide. Copulatory pouch greatly enlarged; wider at ostium, then narrowing distally and curved slightly to the left. Ductus bursae narrowed behind copulatory pouch and sclerotized almost half the distance to the bursa. Bursa copulatrix an elongated sac. Signa well developed, with surface seemingly grooved with fine lines and the edge with saw-tooth projections. Bursa with granulations about bases of signa.

Types. In British Museum. The U. S. National Museum has one "type," presumably a cotype, labeled in Walsingham's writing.

Material examined. (California, 10 specimens, including one male cotype? (see "Types"); Nevada, 1; Utah, 4; New Mexico, 1; and British Columbia, 3.

California distribution. This species is apparently found in dry inland areas or inland mountain ranges. The specimens examined were distributed as follows: Boulevard, San Diego County (July), Geo. H. Field; Providence Mountains, San Bernardino County (April), G. H. and J. L. Sperry; Cuyamaca Lake, San Diego County (August), W. H. Lange; Claremont, Los Angeles County, Metz; Mt. Wilson, Los Angeles County, F. Grinnell, Jr.; Mono Lake, Mono County, J. A. Comstock; Mohawk and Nelson Creek, Plumas County, W. Bauer.

Walsingham took his two types on September 7, 1871, near Lower Klamath Lake, Siskiyou County, California.

Extra-California distribution.[†] Barnes and Lindsey (1921), in addition to California, list Washington, east to Colorado, and Arizona.

The Nevada specimen examined by the writer was taken in the Charleston Mountains, May 14, 1924, by J. A. Comstock. The Utah series was taken at Glendale, June 27, 1941, by Grace H. and John L. Sperry. The single New Mexico specimen was taken at Frijoles Canyon, on September 7, 1941, by G. H. and J. L. Sperry. Two British Columbia specimens were collected at Seton Lake, July 20, 1933, by J. McDunnough, and a single specimen from Wellington, collected by Theo. Bryant.

Discussion. This species is a very difficult one to separate superficially from *shastae* and certain forms of *albiciliata*, and for this reason the genitalia which are very distinct both in the male and female have to be studied. A helpful character is the very long palpi in *fragilis*; the front coming to about the center of the second segment, and on the other species to about the end of the second segment. The color varies from specimens as gray as *shastae* to an almost purplish tint in the Utah specimens. Walsingham's type, which was studied, is a very pale individual, but it undoubtedly is what is taken for this species in the present paper. The body was missing so the genitalic structures of the type could not be examined.

Biology. Braun (1925, 1930) found larvae of this species at Logan, Utah, on July 11, 1924, boring in seed capsules of *Pentstemon cyananthus*; with imagoes emerged from July 27 to August 28 of the same year. In this region *Pentstemon* is a member of the sagebrush association which seems to be the usual habitat for *fragilis*.

Platyptilia maea Barnes and Lindsey

(Plate 11, a; plate 14, c)

maea Barnes and Lindsey, 1921, Pter. of Amer., p. 337, pl. XLIII, fig. 8; McDunnough, 1927, Roy. Soc. Can. Trans., section V:181-82, pl. I, fig. 7; McDunnough, 1939, Check List of Lep., part II:37 (no. 6498).

Male. A uniform grayish-brown species with a light dash on costa above cleft, a dark spot before cleft, and the transverse white line well indicated, especially on first lobe. *Head* light brown with whitish scales; palpi slender, slightly ascending, surpassing frontal tuft; first segment with lighter scales below and above; second segment with terminal tuft of scales which project over third segment; third segment white tipped; frontal tuft short, subtrun-

[†] The writer collected mature larvae of *fragilis* at Kanab, Utah, on June 22, 1949, which were boring inside the buds of *Pentstemon palmeri*. Adults emerged the first week of July.

cate; tuft of scales between antennae; antennae brown, dotted with white scales, especially basally. *Thorax* light grayish brown. *Primaries* in general, a uniform light grayish brown with markings similar to *cooleyi*; usual triangular mark obsolete, but with a dark brown spot before cleft; costal margin dark to beyond spot at cleft, then a light dash which does not quite reach the costa; both lobes uniformly colored, first crossed by an oblique transverse white line which is usually well developed; second lobe with white transverse line, fading out basally; in some specimens a dark patch of scales in cell; fringe of outer margin whitish, tipped with gray, and with dark bases, forming an outer dark line; fringes of cleft grayish white with dark tufts at outer angle; a tuft of dark scales, basally lighter, with two tufts of dark scales, or tufts absent. *Secondaries* a uniform grayish brown, with the inner margin of third feather with bases of fringe white and a few scattered dark scales; in some specimens there is an indication of a scale tuft near the end of the third feather, but it is usually absent. *Abdomen* with first segments lighter, rest rather rough scaled, a light brown, and with scattered white scales. *Legs* slender, chiefly uniform grayish brown; forelegs outwardly brown, inwardly lighter; middle legs with tibiae brown, with white scaling, a pair of terminal spines, and the tarsal segments uniform brown, lighter on inside; hind legs with only slight tufts at spurs; spurs long and slender, especially first pair; color chiefly a uniform grayish brown.

Expanse. 19–25 mm.

Female. Essentially as male.

Male genitalia. Of the same general type of *albida*, *cooleyi*, and *albidorsella*. Differs most conspicuously from *albida* in the slender aedeagus with enlarged apical portion, from *albidorsella* in the uniformly rounded spatulate uncus, and from *cooleyi* in the broader uncus. Harpes with hook-like cucullus bluntly pointed. Uncus spatulate, turned downward at tip. Anellus lobes, two narrow plates set with numerous spines, attached below to the triangular juxta. Saccus well developed, broadly pointed, grooved below. Aedeagus long, slender, enlarged apically.

Female genitalia. I have only one female of this species, which was taken on Mt. Rainier, Washington. The description is from this single example. Lobes of ovipositor wide, set with numerous long setae. Anterior apophyses moderately long, rather stout. Posterior apophyses thorn-like, moderately developed. Genital pouch (base of ductus bursae) longer than in *albidorsella*. Ostium on right side. Bursa copulatrix an elongated sac with the signa well developed; edges of signa slightly toothed; surface of bursa with surface granulations in area about signa.

Types. In the United States National Museum.

Material examined. California, 10 specimens, including one male paratype borrowed from the United States National Museum); Washington, 2; Montana, 2.

California distribution. A high montane species. The type locality is Tuolumne Meadows, Yosemite National Park, California, during July and August. The writer has seen four specimens from Tuolumne Meadows, collected by E. C. Johnston on July 12, 1938. During 1941 I collected one male at Tuolumne Meadows on August 12; four specimens at Porcupine Flat, Yosemite.

ite National Park, on August 13; and one specimen at Lake Mary, Mammoth Lakes, on August 14, 1941.

Extra-California distribution. Lindsey (1921) associated with his types certain material from Alberta, Canada; Colorado, Oregon, and Utah, which may or may not all be this species. I have two specimens from Washington, one from Paradise, Mt. Rainier, August 6, 1919, and a female from Mt. Rainier, collected August 13, 1939, by E. C. Johnston. The two Montana specimens were collected at Richel Lodge, Montana, August 8, 1941, by G. H. and J. L. Sperry.

Discussion. The primaries of one Washington specimen are brighter, have more whitish irroration, and have the triangle faintly indicated. The genitalic features of this specimen are the same as those from Tuolumne Meadows.

Biology. Nothing is known of the early stages, but the larvae probably feed on a member of the family Scrophulariaceae. It is interesting to note that my specimens came to light from 10:30 to 11:00 p.m. at around 8,000–9,000 feet elevation, when most other moths were not flying due to the low temperatures.

Platyptilia cooleyi Fernald

(Plate 11, b; plate 14, g; plate 16, f)

cooleyi Fernald, 1898, Pter. of N. A., p. 30–31; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:443 (no. 4949); Meyrick, 1910, Gen. Insec. fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat. pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5885); Barnes and Lindsey, 1921, Pter. of N.A., p. 338–39, pl. XLIV, fig. 9; McDunnough, 1939, Check List of Lep., part II:37 (no. 6499).
schwarzi Dyar, 1903, Ent. Soc. Wash. Proc., 5:228 (*Stenoptilia*); Meyrick, Gen. Insec. fasc. 100:18 (*Stenoptilia*); Meyrick, 1913, Wagner's Lep. Cat. pars 17:28 (*Stenoptilia*); Barnes and McDunnough, 1917, Check List of Lep., p. 151 (no. 5943); Barnes and Lindsey, 1921, Pter. of N. A., p. 338 (syn. with *cooleyi* Fernald); McDunnough, 1939, Check List of Lep., part II:37 (syn. with *cooleyi* Fernald).

Male. Primaries olive-buff overlaid with grayish scales; costal margin darker except for a light patch beyond base of cleft, and a brown mark at base of cleft. *Head* with palpi porrect, moderate; scales buff except some white on first segment and a few white scales on second segment, above; frontal tuft slight; antennae light brown, with alternate black and white scales basally as seen from above. *Thorax* with tegulae light brown with a few white scales; metathorax pale buff, lighter than the mesonotum. *Primaries* olive-buff (Ridgway, 1919, pl. XL) in general tone composed of gray, white, buff, and brown scales intermingled, lighter toward inner margin; cleft at two thirds from base; a spot of brown scales at base of cleft; costal margin darker, with patches of white scales and extending beyond cleft a short distance as a clear buff patch, then darker to outer white line; first lobe crossed by a transverse, outer white line, dark beyond, fringes grayish, with a basal row of dark brown scales, the posterior margin with grayish-white scales and a darker tuft at anal angle; second lobe lacking outer white line, fringes grayish white with a dark brown tuft at anterior angle, termen with fringe grayish white and basally with row of dark brown scales interspersed with lighter scales; a dark dash in cell at one quarter from base, inner margin with no scale tufts, although a few scattered dark scales, with fringe grayish, lighter at the base and darker toward anal angle. *Secondaries* light grayish brown, slightly darker

than primaries, fringes grayish brown, bases usually paler; third lobe with fringes distinctly paler basally, the distal portions darker than in lobes one and two, especially near the base of wing; and with a few scattered dark scales in fringe near the base of wing. *Abdomen* pale buff at first segment, posteriorly a uniform light brown. *Legs* in general brownish gray with white scales; forelegs light brown inwardly, lighter outwardly; middle legs as forelegs, with long tibial spurs; hind legs brownish gray outwardly but paler inwardly, and with the spurs darker below and lighter above; proximal spurs at two third from base, longer and more slender than distal spurs, inner spine slightly longer; distal spurs of approximately the same length.

Expanse. 22-32 mm.

Female. The female cotype has the lighter costal area indicated only faintly, the dark spot at the base of the cleft is an oblique dash and is more of a vinaceous-buff in color (Ridgway, 1912, pl. XL). In the specimens before me the female, in general, has more distinctive markings, and certain specimens show an indication of the dark triangle on the primaries.

Male genitalia. (Described from cotype.) Similar to *maca* but with the uncus more slender. Harpes with hook-like cucullus with rounded apex. Uncus long, enlarged starting three fifths from base, subspatulate, slightly turned down at apex. Anellus lobes, two narrow plates set with spines, attached below to the triangular juxta. Aedeagus long, slender, enlarged terminally.

Female genitalia. (Described from cotype.) Ovipositor lobes moderate, set with long spines. Anterior apophyses relatively short. Posterior apophyses elongate, slender, enlarged at end. Genital plate broad, bilobed below, with two acutely pointed lobes above. Ostium arising on right side. Copulatory pouch (proximal portion of ductus bursae) enlarged proximally, terminally narrowed. Ductus bursae beyond pouch sclerotized until shortly before it enters bursa. Bursa copulatrix with well-developed, curved signa which are set with rows of minute tooth-like processes.

Types. In the United States National Museum.

Material examined. Two cotypes, male and female, Marshall's Pass, Colorado, July 22, and 15, respectively, 1888; one female, Tennessee Pass, Colorado, August 6-8, 1920, altitude 12,000 feet, July 15, 1932 (A. B. Klots); one female, Mirror Lake, Uinta Mountains, Utah, collected July 12, 1936 (A. B. Klots); and one female, Snowy Range, Albany County, Wyoming, July 17, 1935, elevation 9,800 feet (A. B. Klots).

California distribution. The writer has not seen any specimens of this species from California. The U. S. National Museum lists one male from Placer County in June, which has not been examined. Certain specimens which have been determined by other workers as *cooleyi*, have been referred to *bifida* Lange.

Extra-California distribution. Barnes and Lindsey (1921) report it from Colorado, Arizona, and Nevada (June to August), to which can be added Utah and Wyoming. Dyar's *schwarzi* was taken at Williams, Arizona, during June. The species is chiefly found at considerable elevation in the mountains.

Discussion. The writer has not had an opportunity to examine the type of *schwarzi* Dyar in the National Museum, so must follow Barnes and Lindsey in referring it to this species. This species together with *modesta*, certain speci-

mens of *maea*, and several which cannot as yet be placed in any definite species, have formed an extremely difficult group, chiefly because of the inadequate series available. When specimens of *modesta* from the type locality in California are secured, the exact status of the members in this complex will be placed on a firmer basis.

Biology. The biology is not known, but the food plant should be a member of the family Scrophulariaceae or a related family.

Platyptilia xylopsamma Meyrick

(Plate 12, b; plate 14, e; plate 16, h)

xylopsamma Meyrick, 1908, Ent., Soc. London Trans., 1907:448; Meyrick, 1910, Gen. Insec. fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat., pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5886); Barnes and Lindsey, 1921, Pter. N. A., p. 339, pl. XLIV, fig. 5; McDunnough, 1939, Check List of Lep., part II:37 (no. 6500).

gorgoniensis Grinnell, 1908, Can. Ent., 40(9):321 (*Stenoptilia*); Meyrick, 1913, Wagner's Lep. Cat., pars 17:30 (*Stenoptilia*); Barnes and McDunnough, 1917, Check List of Lep., p. 151 (no. 5948) (*Stenoptilia*).

Male. A uniform brownish-gray species, with a dark costal margin, a dark spot at base of cleft, and the outer pale line absent entirely. *Head* brownish with white scaling; palpi long, slender, third segment turned slightly downward; first segment with lighter scales below and above; second segment rough scaled, with projecting scales above and terminally, and with a tuft projecting under the third segment; third segment slender, light scaled above; frontal tuft short, wide, blunt; tuft of scales between antennae; antennae with banded effect with alternate white and brown scales. *Thorax* brownish gray with white irroration. *Primaries* brownish gray, composed of brown, gray, and white scales intermingled; costa dark entire length to apex; a dark spot before cleft with often an indication of a gray patch above, where triangle would be; in some specimens a dark patch in cell, one third from base of wing; a lighter streak along radius to beyond triangle in some specimens; fringe of outer margin grayish white with grayish apices and dark bases; cleft with fringe grayish white with dark tufts at outer angle; inner margin with grayish fringe having white bases, and darker before anal angle. *Secondaries* brownish gray with bases of fringe lighter, especially along inner margin of third lobe; scale tuft in fringe of third lobe absent, although a few scattered dark scales may occur. *Abdomen* lighter at first segments, the rest grayish brown with intermingled white and fuscous scales. *Legs* chiefly unicolorous; forelegs brown above, white below; middle legs mostly brown, with a well-developed pair of spurs, the tarsal segments uniform dark brown; hind legs dorsally, and at base of tibiae with light irroration; spurs long, white above, brown below.

Expanse. 24–31 mm.

Female. As male.

Male genitalia. Similar to *albida*. Harpes long, with long, hook-like cucullus bluntly rounded apically; sacculus inflated medially. Uncus long, widened before apex, subspatulate. Anellus lobes two narrow plates produced terminally, attached ventrally to a triangular juxta. Saccus acutely pointed

above, grooved below. Aedeagus short, stout, noticeably swollen basally, but not apically as in *albidorsella* and *maea*.

Female genitalia. Ovipositor lobes wide, with numerous very long hairs. Anterior apophyses moderately long, stout. Posterior apophyses moderately long. Median plate produced medially into a bilobed plate, dorsally having the usual bilobed roughened lobes. Ostium arises on right side, wide. Copulatory tube is wide proximally, rather abruptly shortened, with ductus bursae narrowed but sclerotized for a considerable distance. Signa of bursa very long, thorn-like, armed with short saw-tooth projections.

Types. The type of *xylopsamma* is in the British Museum. The specimen of *Stenoptilia gorgoniensis* Grinnell has apparently been destroyed, as only the pin and label remained when the author examined the Los Angeles Museum collection in 1938.

Material examined. Arizona, 1 (July); Colorado, 5 (July).

California distribution. The writer has not seen a specimen of this species from California. Grinnell's *gorgoniensis* was collected in the San Bernardino Mountains of southern California. The U. S. National Museum lists one male, determined by Meyrick, from Claremont, California.

Extra-California distribution. This species has been recorded from Colorado, Utah, and Arizona. Three specimens examined were collected in the Rocky Mountain National Park on July 24, 1936, by A. H. Andrews and Lloyd M. Martin. The Arizona specimen was taken in the Chiricahua Mountains, elevation 9,800 feet, on July 30, 1927, by J. A. Kusche. One specimen was taken at Estes Park, Colorado, by G. H. and J. L. Sperry on July 22, 1936, and the other at Rock Creek, near Colorado Springs, July 9, 1935, by A. B. Klots.

Discussion. This species seems very distinct in genitalic features, large size, dark costal margin, and absence of an outer white line on the primaries.

Biology. Nothing is known of the early stages. Judging from morphological similarities the food plant is perhaps in the family Scrophulariaceae.

Platyptilia modesta (Walsingham)

(Plate 12, a)

modestus Walsingham, 1880, Pter. Calif. and Ore., p. 18-20, pl. I, fig. 14 (*Platyptilus*).
modesta, Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4558); Fernald, 1898, Pter. N. A., p. 31; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:443 (no. 4950); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Meyrick, 1910, Gen. Insec., fasc. 100:12; Meyrick, 1913, Wagner's Lep. Cat., pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5888); Barnes and Lindsey, 1921, Pter. N. A., p. 340, pl. XLIII, fig. 12, pl. L, fig. 7 (*ex parte*); McDunnough, 1939, Check List of Lep., part II:37 (no. 6501).

Male. A uniform grayish-brown species with the light costal spot (as found in *cooleyi*) absent, with a dark spot before cleft and a tendency toward complete obliteration of the outer pale line. *Head* with palpi brown with lighter scales below on first segment; second segment with a projecting apical tuft of scales to end of third segment; third segment slender, pointed, light-tipped; all segments with white scales above; frontal tuft moderate, subtruncate; tuft of scales between bases of antennae; antennae uniformly brown or with a partial white streak, basally. *Thorax* buff to brown, with white scales.

Primaries grayish brown irrorated with white scales; costal edge slightly darker; a dark-brown dot before cleft; outer transverse white line faintly visible on first lobe, absent on second; fringe of outer margin grayish white with dark tufts at outer angles; dark tuft at anal angle of second lobe; fringe of inner margin gray with whitish bases and often a patch of white scales just before angle; no scale marks, although an occasional dark scale. *Secondaries* uniform grayish brown; fringe of inner margin of third lobe darker and with pale bases and a few scattered dark scales. *Abdomen* paler at first segments, rest buff to brown with scattered white scales. *Legs* mostly uniform brown; forelegs darker above, with darker area extending down tarsal segments; middle legs brown with well-developed spurs at apices of tibiae; hind legs with tibiae lighter basally, becoming darker toward spurs; spurs very long, slender, tarsal segments unicolorous, grayish brown.

Expanse. 21–26 mm.

Female. The single female examined, which has been compared with the type in the British Museum by Meyrick, is from Ft. Wingate, New Mexico. This specimen is smaller than the others examined (21 mm.), is unicolorous, lacks the outer transverse line, and shows a dark spot in cell of primaries. It appears more like the cotype, female, of *cooleyi*, discussed under this species.

Genitalia. See under "Discussion" in later paragraph.

Types. In the British Museum.

Material examined. New Mexico (August) 1, female, compared with type by Meyrick; Alberta, Canada (August), male (U. S. National Museum); Yellowstone National Park, Wyoming (July), (U. S. National Museum); Awene, Manitoba, Canada (June), female (J. McDunnough).

California distribution. I have not seen a California specimen which can be referred to this species. Walsingham's types were taken at Mendocino, California, but it has not been located at this locality. The one California specimen of *modesta* in the U. S. National Museum proved referable to *pica* var.

Extra-California distribution. Barnes and Lindsey listed this species from northern California to Colorado, New Mexico, and Arizona (April, June, July, August). Probably the Arizona specimens are referable to *bifida* Lange. The exact distribution will depend upon the future determination of the exact taxonomic limits of this species.

Discussion. The meager assortment of specimens which have been referred in this paper to *modesta* makes it impossible to determine the exact limits of this species. Until material from the type locality is examined we will have to withhold final judgment.

The single female compared by Meyrick with the type of *modesta* in the British Museum may be this species, but inasmuch as the genitalia were not examined in many of Meyrick's determinations, we can place no absolute trust in this specimen. The anal angle of the third lobe of the primaries is considerably weaker than Walsingham's figure and description. The female genitalia of this specimen are similar to *cooleyi*, but the genital plate shows a central, posteriorly directed bifid lobe beneath, and the copulatory pouch is wider and not so elongate.

The female from Manitoba, Canada, is more like the cotype, female, of *cooleyi*, showing a light area on the costal margin, and two dark scale patches

on the inner margin of the primaries which are not shown in other specimens of *cooleyi* and "*modesta*."

The male representative from Alberta, Canada, is the most unicolorous and lightest specimen seen, whereas the Yellowstone male is the darkest. The genitalia of these two specimens are larger than any *cooleyi* seen. In addition, the uncus is more spatulate and has a point apically. These features place them closer to *maea*.

TABLE 8
SYNOPSIS OF MALE GENITALIA

Species and locality	Length of aedeagus	Length and width of uncus	Length and width of harpe	Length of anellus lobes	Width of sacculus
	(In numbers of units. One unit is equal to 0.018 mm.)				
<i>xylopsamma</i> , Colorado.....	40	29×5	57×17	16	13
<i>xylopsamma</i> , Colorado.....	37	30×5.5	53×15	15	13
<i>cooleyi</i> , cotype, Colorado.....	43	24×5	54×15	15	11
<i>modesta</i> (?), from U. S. Nat. Mus., Yellowstone, Wyoming.....	53	28×7	65×15	17	11
<i>modesta</i> (?), from U. S. Nat. Mus., Alberta, Can. ...	50	30×7	70×15	16	12

TABLE 9
SYNOPSIS OF FEMALE GENITALIA

Species and locality	Width of ductus bursae at ostium	Length of chitinated portion of ductus bursae	Width of signa	Length of signa	Length of anterior apophyses	Length of posterior apophyses
	(In numbers of units. One unit is equal to 0.018 mm.)					
<i>xylopsamma</i> , Colorado..	13	15	7	26	65	15
<i>cooleyi</i> , cotype, Colorado.....	10	27	5	21	40	16
<i>cooleyi</i> (?), Colorado....	10	20	5	19	34	13
<i>modesta</i> , New Mexico (det. Meyrick).....	10	17 (?)	7	25	49	12

A synopsis of the genitalia of specimens referable to *modesta* together with the related species, *cooleyi* and *xylopsamma*, is presented in tables 8, 9.

Platyptilia bifida Lange, new species

(Plate 11, c; plate 14, f)

Male. Appearing as *cooleyi* Fernald, especially the female, but is distinctive in having a very noticeable bifid frontal tuft and uniform light grayish-brown primaries with no indication of a subterminal white line. *Head* grayish brown; palpi slightly ascending, surpassing frontal tuft; first segment with whitish scales below and above; second segment rough scaled, with scales distally projecting over third segment; third segment white scaled, mostly obscured by scales of second; frontal tuft prominent, noticeably bifid, rough scaled; tuft between antennae rough scaled; antennae dark brown with white scales

basally. *Thorax* generally grayish brown with some fuscous scales. *Primaries* a uniform light grayish brown, composed of white, gray, light and dark brown scales intermingled; a dark spot just before cleft; lobes slightly lighter than basal part of wing, with somewhat indefinite longitudinal lighter streaks which are especially noticeable on the first lobe; fringes of outer margin of lobes light at base, then a dark area followed apically by grayish white; fringe of cleft and inner margin with light bases and fuscous tips; a few scattered dark scales along inner margin, but no scale tuft present; basal part of wing shows a lighter area below cubitus vein; undersides light brown, with lobes lighter in color. *Secondaries* a uniform grayish brown with the fringes lighter at their bases especially along the posterior margin of third feather; a few scattered dark scales along posterior margin of third feather, but no scale tuft present. *Abdomen* somewhat stained, but apparently light brown with an indication of a subdorsal longitudinal darker line and darker scales at posterior margin of the segments. *Legs* without distinctive markings, white to buff-brown in color; tibiae of forelegs brown with an outer white line; first tarsal segment buff with rest light grayish brown; middle legs with a pair of long tibial spurs and the tarsal segments uniform grayish brown; hind legs mostly white above, darker below; first pair of spurs long, slender, white striped above, with inner spines longer; second pair of spurs shorter, white above; tarsal segments white above, darker at posterior junctions of segments, and grayish brown below.

Expanse. 23.5 to 26 mm.

Male genitalia. Distinguished by the slender uncus. General type similar to *carolina* Kearfott. Harpes with distal hook-like cucullus thick; bluntly rounded; sacculus prominent, with a noticeable expansion just before base. Uncus evenly slender with enlarged base, set with a few very small spines. Anellus lobes short, set with spines and connecting basally with a triangular basal plate. Saccus produced, heart-shaped, with a noticeable ventral groove. Aedeagus short, inflated noticeably at base, inflated slightly at apex, with a few teeth.

Types. *Holotype*, male, Huachuca Mountains, southern Arizona, May 28, 1935, collected by J. A. Comstock. To be deposited in the collection of J. A. Comstock, Los Angeles Museum, Los Angeles, California.

Discussion. I associate with the type a specimen from Mint Canyon, Acton, California, collected May 31, 1920, but because of its poor condition am not including it as a type. The front of this specimen, which was denuded of scales, shows a raised tubercle-like projection on each side. In *cooleyi* the front is smooth.

The characters separating this species from *cooleyi* have already been mentioned, but include the bifid frontal tuft, uniform color with no transverse white line more as in *modesta* (Walsingham) and the uniformly slender uncus with nonspatulate apex. It differs from what I am calling *modesta* (Walsingham) by the bifid frontal tuft, and the slender uncus. The apex is spatulate in *modesta* (Walsingham).

Lindsey (1921) apparently confused this species with *modesta* (Walsingham) as his figure of *modesta* from the Huachuca Mountains of Arizona (plate XLIII, fig. 12) is apparently *bifida*.

SPECIES OF DOUBTFUL OCCURRENCE IN CALIFORNIA

The next three species, and one subspecies, have either been reported from California and the writer has not been able satisfactorily to show their presence in the state, or the specimens have not been in good enough condition to provide adequate means of study of their characters. Further collecting may show them to be found in California.

Platyptilia tesseradactyla (Linnaeus)

- tesseradactyla* Linnaeus (nee Zetterstedt), 1761, Faun. Suec. p. 370 (no. 1454) (*Alucita*); Heinemann & Wocke, 1876, Kleinschm., 2:2, 787; Zeller, 1878, Stett. ent. Zeit., 39: 162; Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4551); Hofmann, 1895, Ber. Nat. Ver. Regensb., 5:51; Barrett, 1897, Ent. Mag., 33:25-26, 62; Fernald, 1898, Pter. N.A., p. 33, pl. VIII, fig. 8, 9; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus., Bul. 52:444 (no. 4955); Dyar, 1904, U. S. Nat. Mus. Proc., 27:923; Anderson, 1904, Cat. Brit. Col. Lep., p. 50 (no. 991); Brit. Col. Ent. Soc. Check List, 1906, p. 42; Tutt, 1906, Brit. Lep., 5:175; Meyrick, 1910, Gen. Insec., fasc. 100:11; Winn, 1912, List Ins. Que., p. 85; Meyrick, 1913, Wagner's Lep. Cat., pars 17:13-14; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5870); Barnes and Lindsey, 1921, Pter. N. A. p. 323-24, pl. XLI, fig. 17, pl. L, fig. 8; McDunnough, 1939, Check List of Lep., part II:37 (no. 6474); Huggins, 1939, The Ent., 72:177-78 (biol.).
- tessaradactyla*, Hofmann (clerical error), 1895, Deutsch Pter., p. 64, 75 (biol.).
- tesseradactylus*, Fabricius, 1787, Mant. Ins., 2:259 (*Pterophorus*).
- fischeri* Zeller, 1841, Isis, 10:781 (*Pterophorus*); Tengström, 1847, Not. Sällsk. Faun. Fenn. Förh., 1:155; Zeller, 1851, Linn. Ent., 6:337 (*Pterophorus*); Herrich-Schäffer, 1855, Schmett. Eur., 5:369, fig. 12; Frey, 1856, Tin. Pter. Schweiz, p. 405; Cartner, 1862, Wien Ent. Mon., 6:330-32 (*Platyptilus*).

The only possible record of this species from California is a specimen in the California Academy of Sciences collection, collected at Glen Alpine Creek, El Dorado County, on July 15, 1909, by F. X. Williams. Inasmuch as the specimen lacks the hindwings and abdomen, it will perhaps be better to reserve judgment until further material can be collected. It occurs in the state of Washington and in Colorado, so its range could very well include California.

The host plants in Europe are reported to be *Gnaphalium dioicum* and *G. arenarium*, members of the family Compositae.

Platyptilia albicans (Fish)

(Plate 5, d)

- albicans* Fish, 1881, Can. Ent., 13:71 (*Platyptilus*); Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4550); Fernald, 1898, Pter. N. A., p. 32-33, pl. VIII, fig. 12, 13; Fernald, 1902 (Dyar's List of Lep.), U. S. Nat. Mus. Bul. 52:443 (no. 4954); Meyrick, 1910, Gen. Insec., fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat., pars 17:15; Barnes and McDunnough, 1917, Check List of Lep., p. 150 (no. 5880); Barnes and Lindsey, 1921, Pter. N. A., p. 341-42, pl. XLIII, fig. 11, pl. L, fig. 12; McDunnough, 1939, Check List of Lep., part II: 37 (no. 6481).

The U. S. National Museum listed a specimen of this species from California, but on examination it proved to be a stunted specimen of *pallidactyla* (Haworth). There was no data with this specimen, except "Cal." and the body was missing.

Platyptilia carolina Kearfott

(Plate 10, b; plate 13, l)

carolina Kearfott, 1907, Amer. Mus. Nat. Hist. Bul. 23:155, pl. VIII, fig. 17; Meyrick, 1913, pars 17:16; Barnes and McDunnough, 1917, Check List of Lep., p. 150; Barnes and Lindsey, 1921, Pter. N. A., pp. 327-328, pl. XLI, fig. 16, pl. L, fig. 15; Forbes, 1923, Lep. of New York, p. 643; Brimley, 1938, Insec. North Carolina, p. 302; McDunnough, 1939, Check List of Lep., part II:37.

The single specimen determined as *carolina* by Barnes and Lindsey (1921) from Carmel, in June (A. H. Vachell, collector), has been borrowed from the U. S. National Museum and found to be a rather faded specimen of *albiciliata rubricans* Lange. This specimen has a short, truncate frontal tuft, while *carolina* has a conical frontal tuft.

The drawings of the adult, and of the male genitalia, have been prepared from one of two of Kearfott's cotypes which were borrowed from the U. S. National Museum.

Platyptilia albiciliata orthocarpi (Walsingham), new combination

(Plate 9, c)

orthocarpi Walsingham, 1880, Pter. Calif. and Ore., p. 11-12, pl. 1, fig. 9 (*Platyptilus*) (new syn.); Dimmock, 1882, Psyche, 3:403 (*Platyptilus*); Hy. Edwards, 1889, U. S. Nat. Mus. Bul. 35:136 (*Platyptilus*); Fernald, 1891, Smith's List Lep. N. A., p. 87 (no. 4553); Fernald, 1898, Pter. N. A., p. 29; Fernald, 1902 (Dyar's List Lep.), U. S. Nat. Mus. Bul. 52:443; Meyrick, 1910, Gen. Insec. fasc. 100:11; Meyrick, 1913, Wagner's Lep. Cat. pars 17:14; Barnes and McDunnough, 1917, p. 150 (no. 5873); McDunnough, 1939, Check List of Lep. part II:37 (no. 6495).

The writer has not seen typical *orthocarpi* from California, although certain specimens from the Lake Tahoe region approach it very closely.

A study of a typical specimen of *orthocarpi* from British Columbia, collected by G. O. Day, June 11, 1909, and figured by Barnes and Lindsey (1921) in their monograph, indicates that *orthocarpi* is a subspecies, or perhaps just a variety, of *albiciliata*. Of the specimens sent as *orthocarpi* by the U. S. National Museum, one was *fragilis* (Walsingham) and the others from Deer Park Springs, Lake Tahoe (July), are perhaps an undescribed subspecies of *albiciliata*, near *orthocarpi*. I have hesitated to describe the latter until further material can be collected. It is interesting to note that Meyrick determined one of the Deer Park Springs specimens as *fragilis* (Walsingham). The color patterns of these approach each other closely, but the genitalic features are distinct.

One specimen sent as *orthocarpi* which has been examined, was sent with the material from the University of British Columbia, and was a part of the Blackmore collection. This specimen is quite dark, with the characteristic dash at the center of the first lobe of the primaries replaced by a uniform dark brown area. The body is missing so a genitalic slide is not possible.

The host plant of *orthocarpi* will probably prove to be a *Castilleia*, as Walsingham's *Orthocarpus* in several other cases where the host plant is definitely known actually referred to *Castilleia*. The host of *albiciliata albiciliata* and *albiciliata rubricans* is *Castilleia latifolia*.

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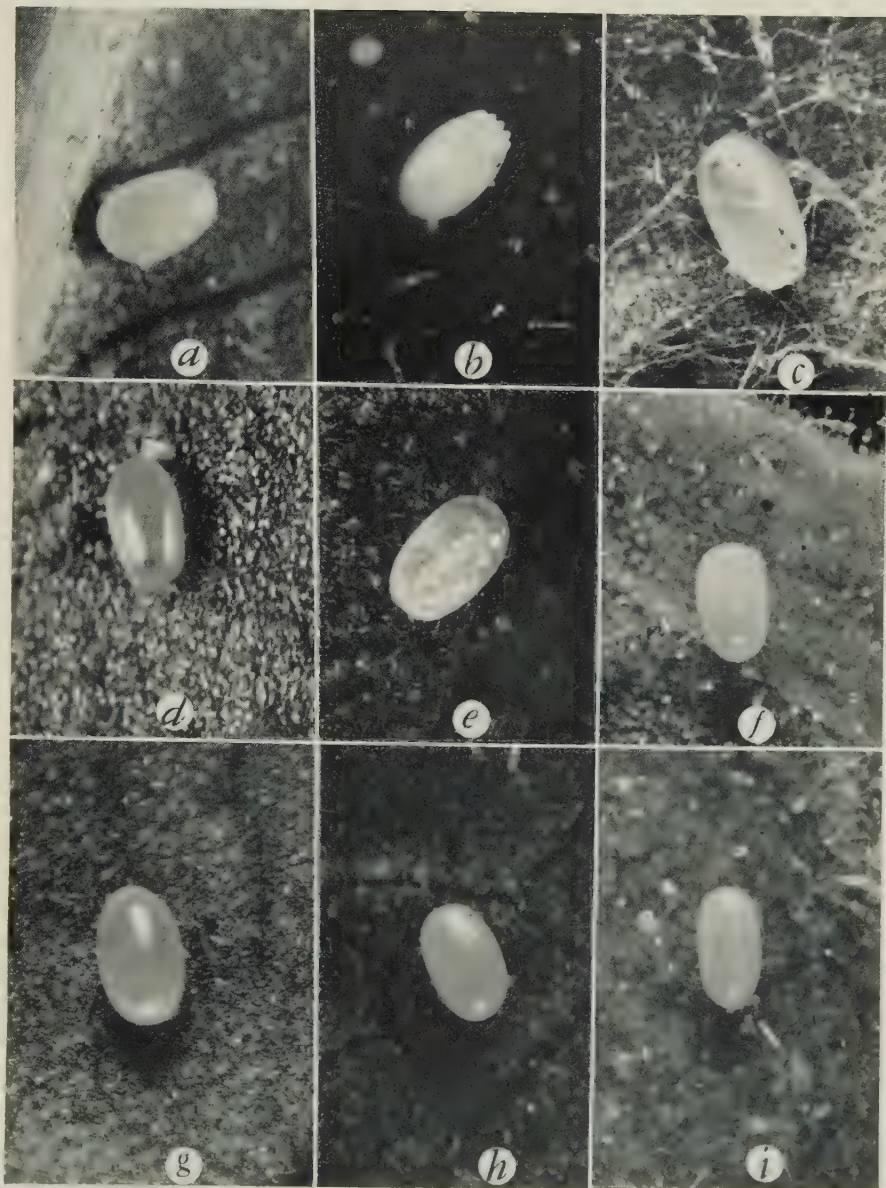


Plate 1. Eggs of *Platyptilia* species: a, *P. percnodactyla* (Walsingham) ($\times 30$); b, *P. fuscicornis* Zeller ($\times 30$); c, *P. carduidactyla* (Riley) ($\times 30$); d, *P. williamsii* Grinnell ($\times 33$); e, *P. antirrhina* Lange ($\times 45$); f, *P. pica sierrae* Lange, new subsp. ($\times 30$); g, *P. pica crataea* Fletcher, new comb. ($\times 33$); h, Cross of male *P. pica marina* and female *P. pica crataea* ($\times 30$); i, *P. albiciliata rubricans* Lange, new subsp. ($\times 30$).

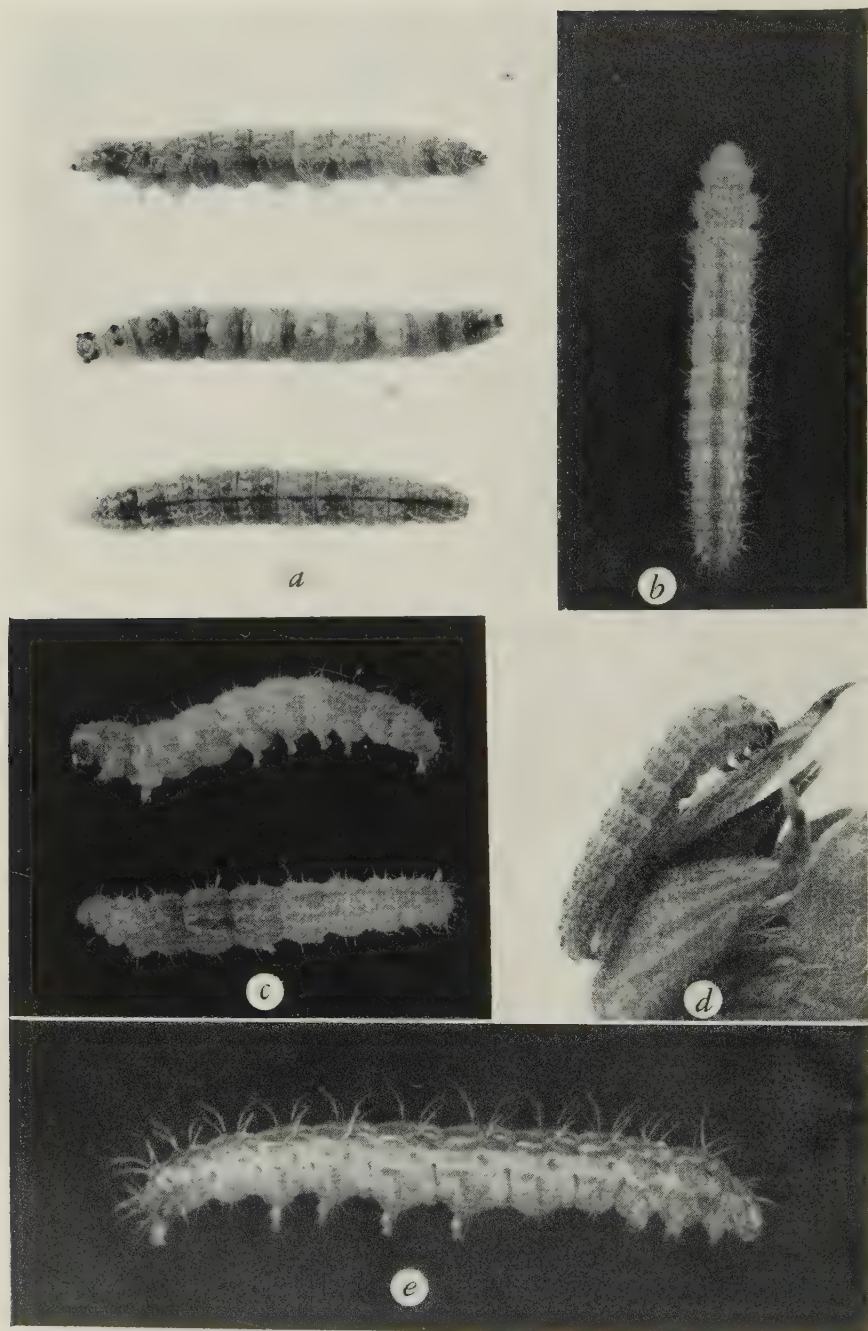


Plate 2. Mature larvae of *Platyptilia* species: a, *P. pica crataea* Fletcher, new comb. (lateral, ventral, dorsal views) ($\times 5$); b, *P. albiciliata rubricans* Lange, new subsp. ($\times 6$); c, *P. pica sierrae* Lange, new subsp. ($\times 5$); d, *P. fuscicornis* Zeller, on black sage; e, *P. antirrhina* Lange ($\times 10$).

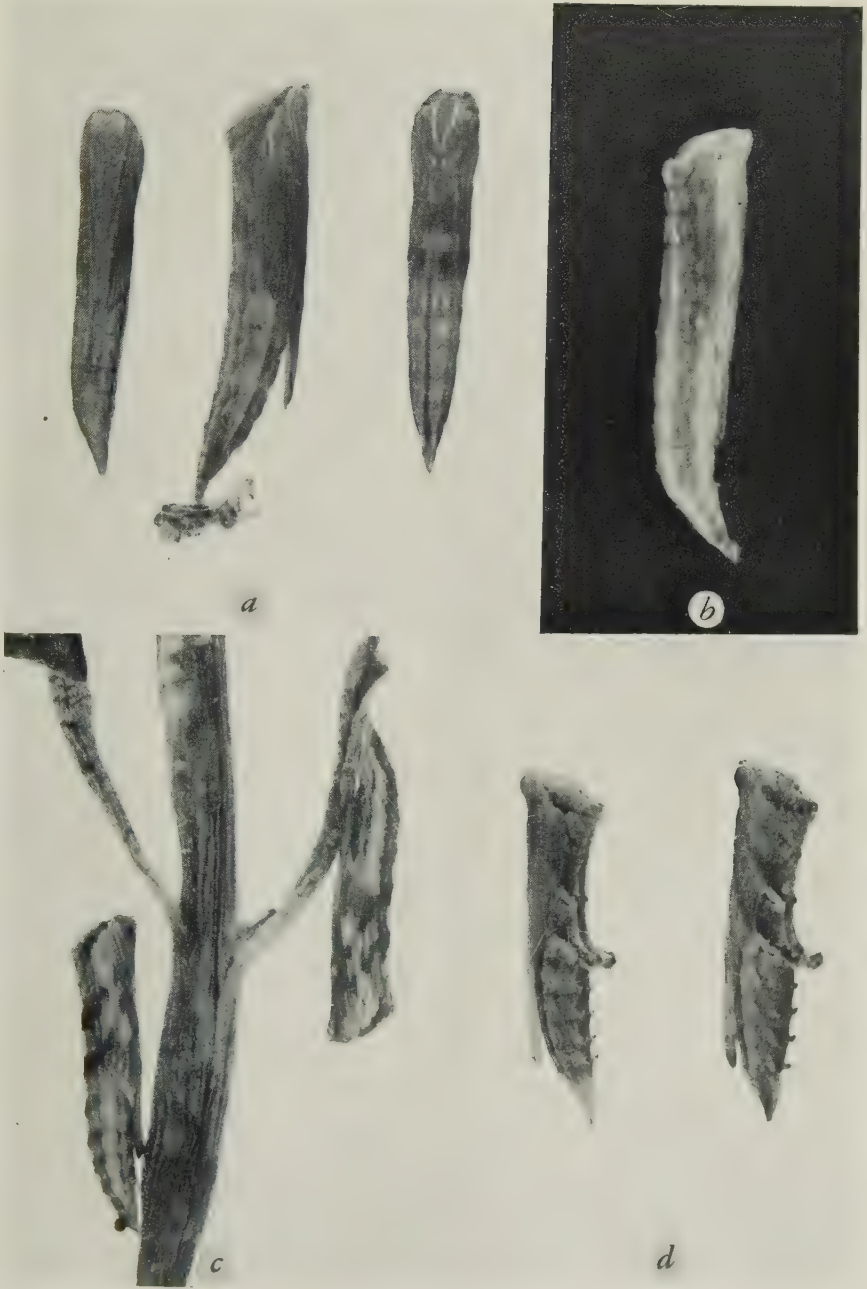


Plate 3. Pupae of *Platyptilia* species: a, *P. albiciliata rubricans* Lange, new subsp. ($\times 3$); b, *P. shastae* (Walsingham) ($\times 6$); c, *P. antirrhina* Lange, on snapdragon ($\times 5$); d, *P. fuscicornis* Zeller ($\times 5$).



Plate 4. Pupae of *Platyptilia* species: *a*, *P. pica crataea* Fletcher, new comb., with cast skin ($\times 9$); *b*, *P. carduidactyla* (Riley) ($\times 6$).

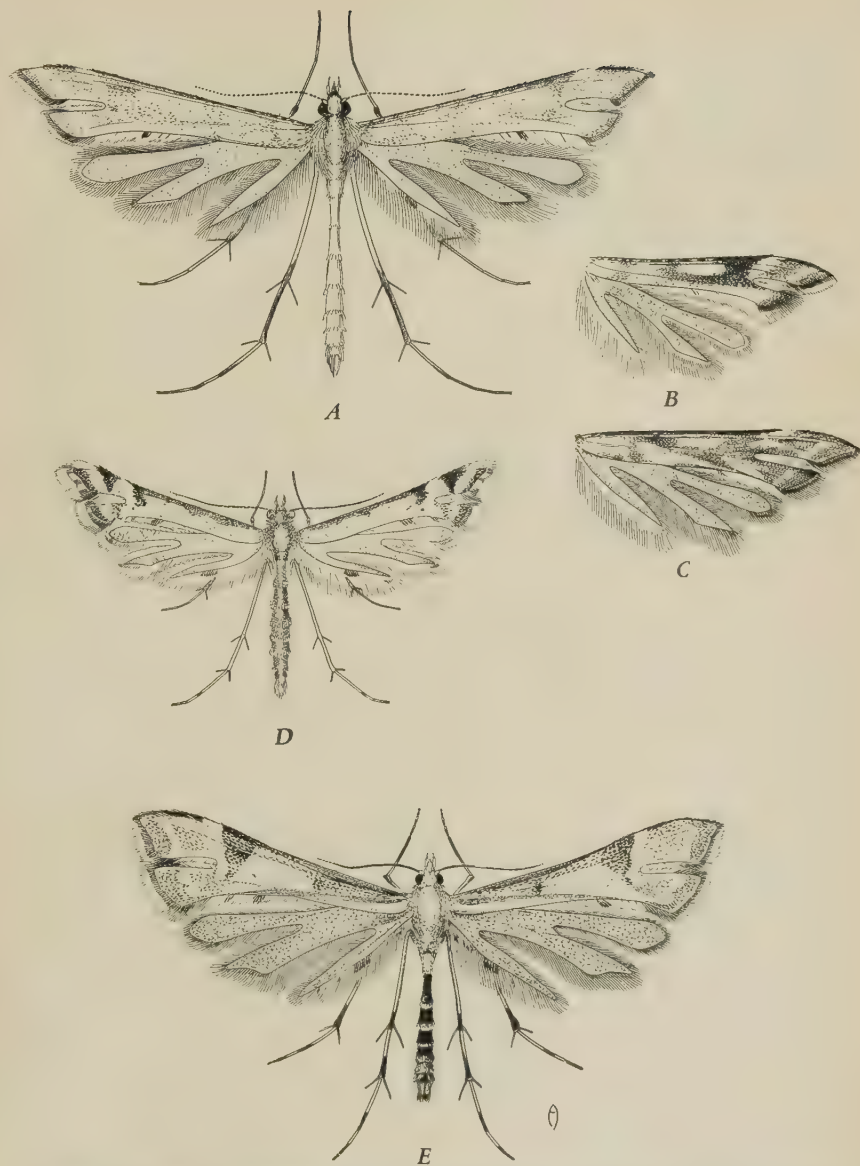


Plate 5. Adults of *Platyptilia* species: *a*, *pollidactyla* (Haworth), male, England; *b*, *pallidactyla* (Haworth), female, wings on one side, California; *c*, *pallidactyla* (Haworth), male, wings on one side, California; *d*, *albicans* (Fish), male; *e*, *percnodactyla* (Walsingham), male.

(All drawings in plates 5 to 12, unless otherwise indicated, were made by Frieda Abernathy.)

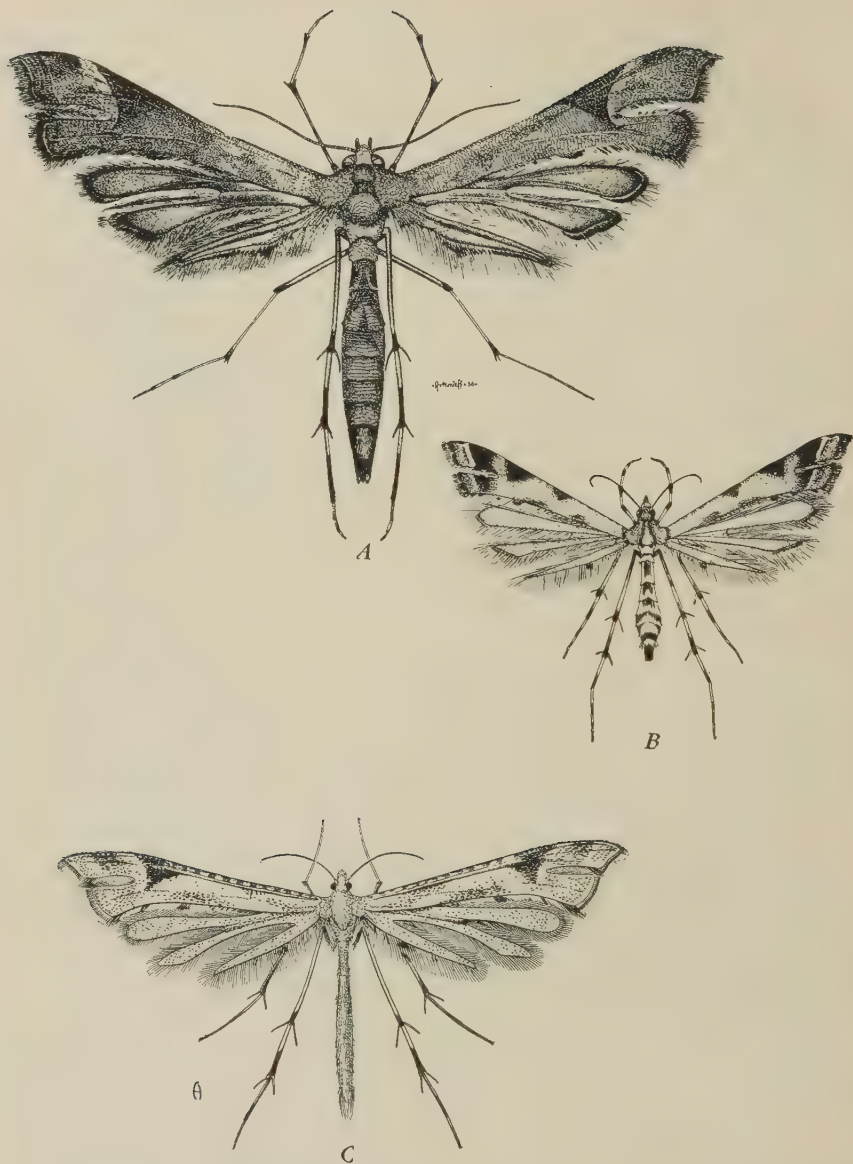


Plate 6. Adults of *Platyptilia* species; *a*, *carduidactyla* (Riley), female. (Drawing by P. Artemieff); *b*, *williamsii* Grinnell, female. (Drawing by A. McBride); *c*, *gonodactyla* (Schiffermüller), male, Europe.

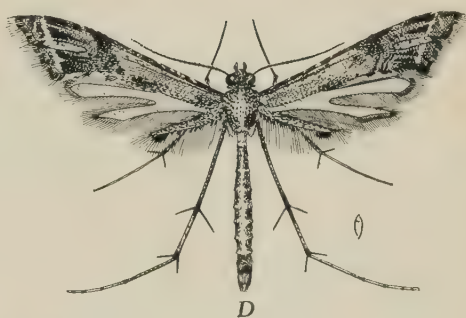


Plate 7. Adults of *Platyptilia* species: *a*, *pica crataea* Fletcher, new comb., male; *b*, *pica pica* (Walsingham), female, Wellington, British Columbia (compared with type in British Museum by E. Meyrick); *c*, *taprobanes* (Felder), male; *d*, *antirrhina* Lange, male; *e*, *pica sierrae* Lange, new subsp., female; *f*, *fuscicornis* Zeller, male. (Drawings for *a*, *b*, *c*, *f*, by A. McBride.)

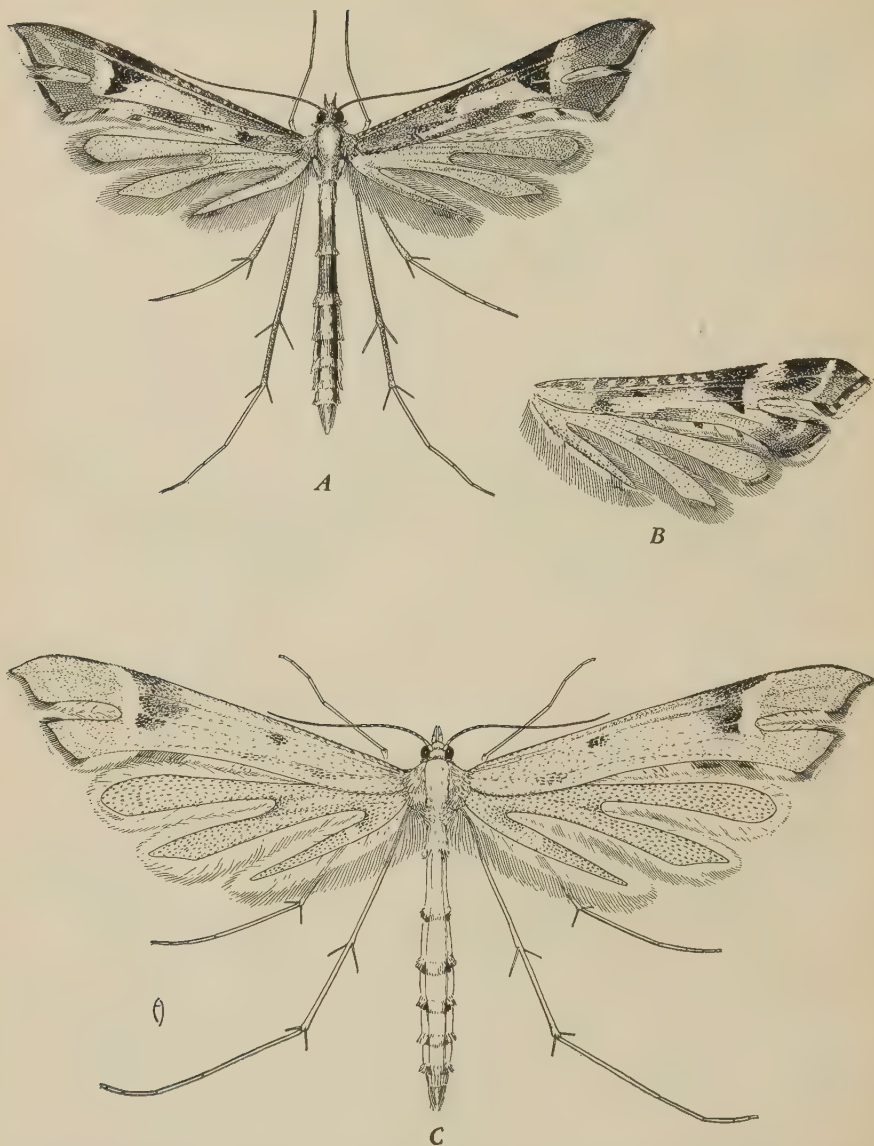


Plate 8. Adults of *Platyptilia* species: *a*, *baueri* Lange, new sp., female; *b*, *edwardsii* Fish, male, wings on one side; *c*, *grandis* (Walsingham), female, Siskiyou County, California. (Compared with paratype in Pernald collection by A. W. Lindsey, November 9, 1920.)

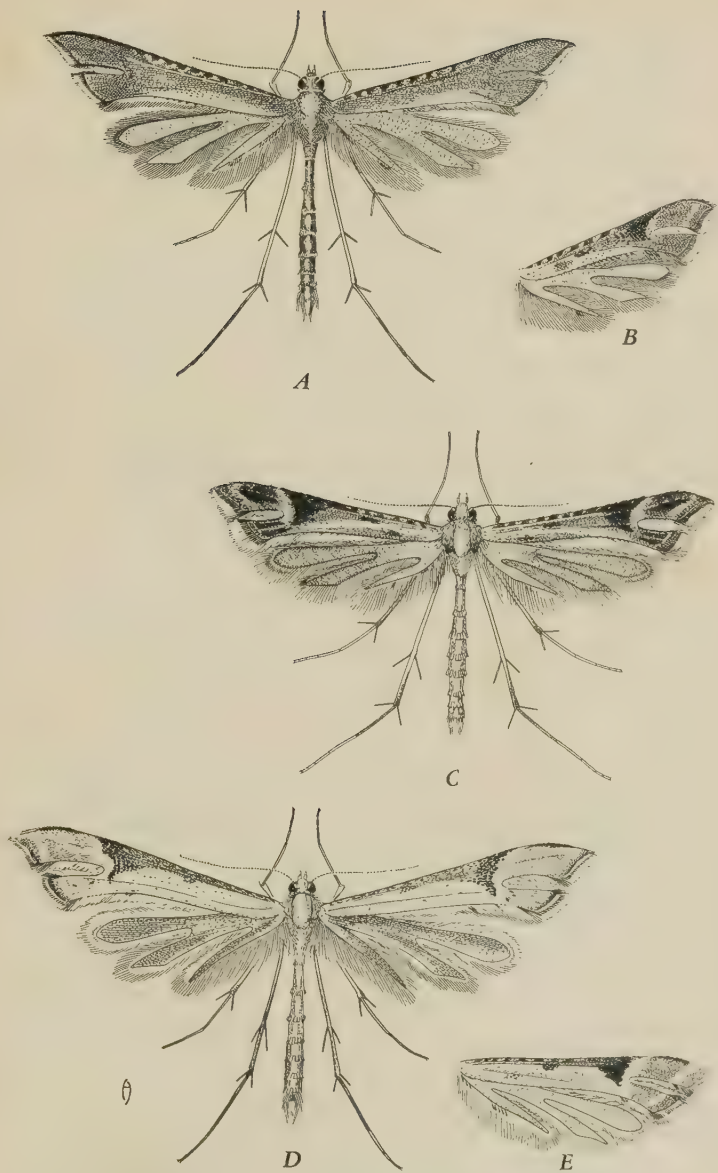


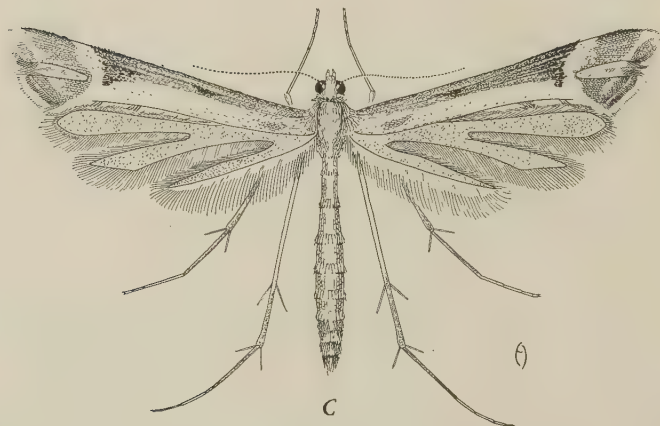
Plate 9. Adults of *Platyptilia* species: *a*, *albiciliata albiciliata* (Walsingham), male; *b*, *albiciliata rubricans* Lange, new subsp., female, wings on one side; *c*, *albiciliata orthocarpi* (Walsingham) new comb., sex ?, British Columbia; *d*, *lutescens* Lange, new sp., male; *e*, *fragilis* (Walsingham), male, wings on one side.



A



B

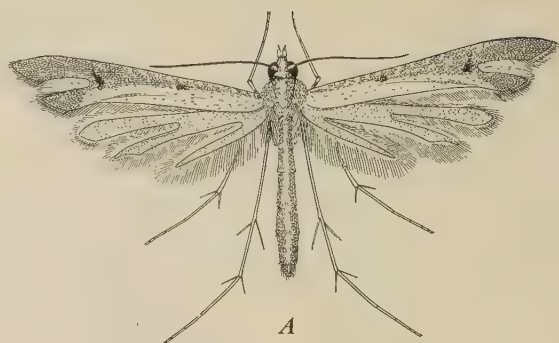


C

Plate 10. Adults of *Platyptilia* species: *a shastae* (Walsingham), male; *b, carolina* Kearfott, male, North Carolina (cotype); *c, albida* (Walsingham), sex ♀.



Plate 11. Adults of *Platyptilia* species: *a*, *maca* Barnes and Lindsey, male; *b*, *cooleyi* Fernald, male, Colorado (cotype); *c*, *bifida* Lange, new sp., male.



A



B



C

Plate 12. Adults of *Platyptilia* species: *a*, *modesta* (Walsingham), female, New Mexico, (compared with type in British Museum by E. Meyrick); *b*, *xylopsamma* Meyrick, male; *c*, *albidorsella* (Walsingham), sex ♀, San Diego, California. (Compared with type in British Museum by E. Meyrick.)

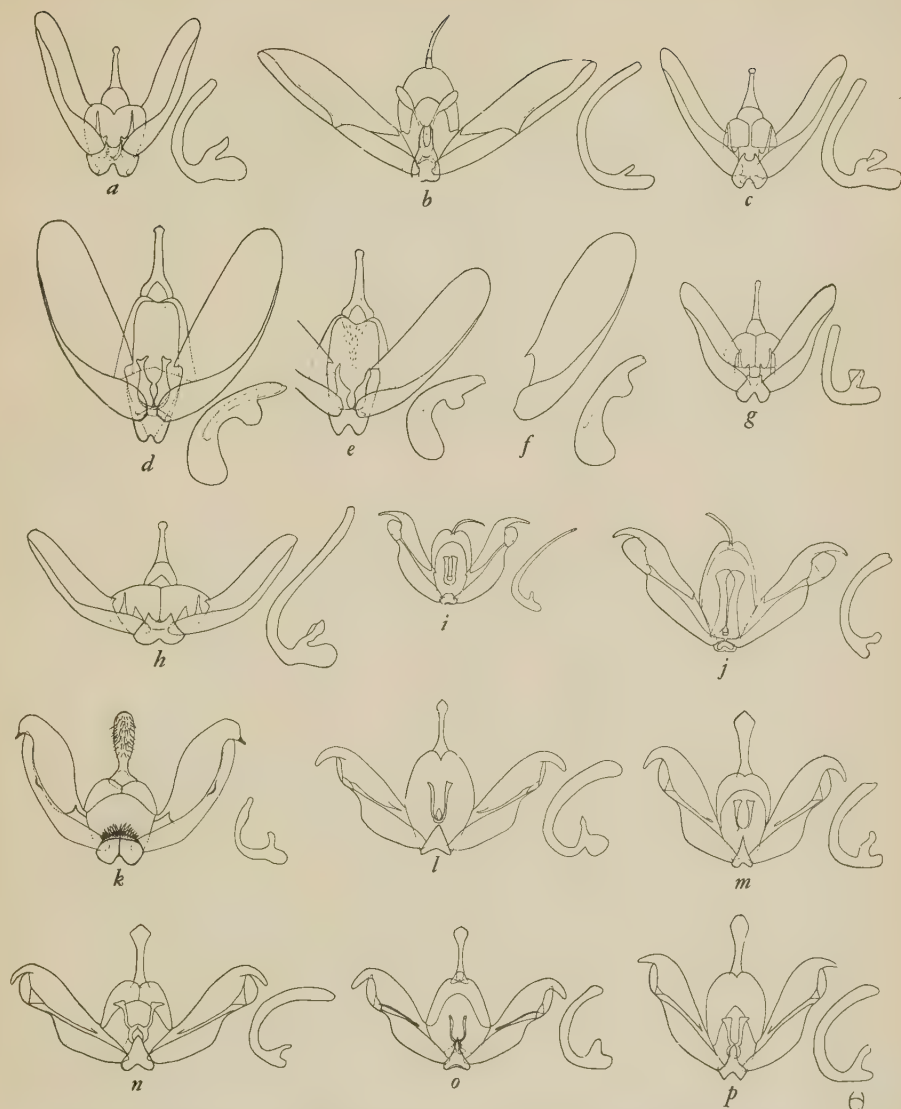


Plate 13. Male genitalia of *Platypstia* species: *a*, *gonodactyla* (Schiffermüller); *b*, *fuscicornis* Zeller; *c*, *carduidactyla* (Riley); *d*, *e*, *f*, *pallidactyla* (Haworth) (*d*, England; *e*, California; *f*, Pennsylvania); *g*, *williamsii* Grinnell; *h*, *perenodactyla* (Walsingham); *i*, *taprobanes* (Felder); *j*, *antirrha* Lange; *k*, *pica monticola* (Grinnell) new comb. (type); *l*, *carolina* Kearfott (cotype); *m*, *albiciliata canadensis* McDunnough; *n*, *albiciliata albiciliata* (Walsingham); *o*, *lutescens* Lange, new sp.; *p*, *albida* (Walsingham).

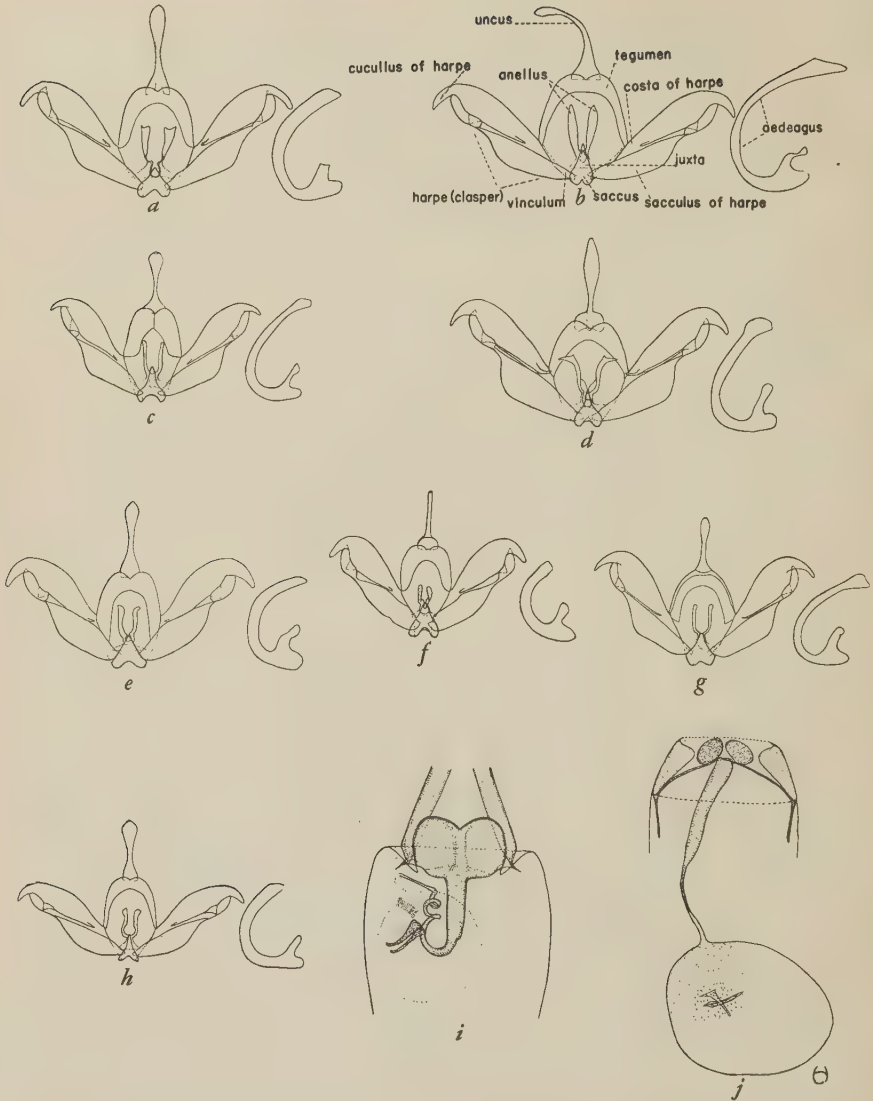


Plate 14. Male genitalia of *Platyptilia* species: a, *albida* (Walsingham) (cotype); b, *fragilis* (Walsingham); c, *maea* Barnes and Lindsey; d, *albidorsella* (Walsingham); e, *xylopsamma* Meyrick; f, *bifida* Lange, new sp.; g, *cooleyi* Fernald (cotype); h, *shastae* (Walsingham). Female genitalia of *Platyptilia* species: i, *fuscicornis* Zeller; j, *williamsii* Grinnell.

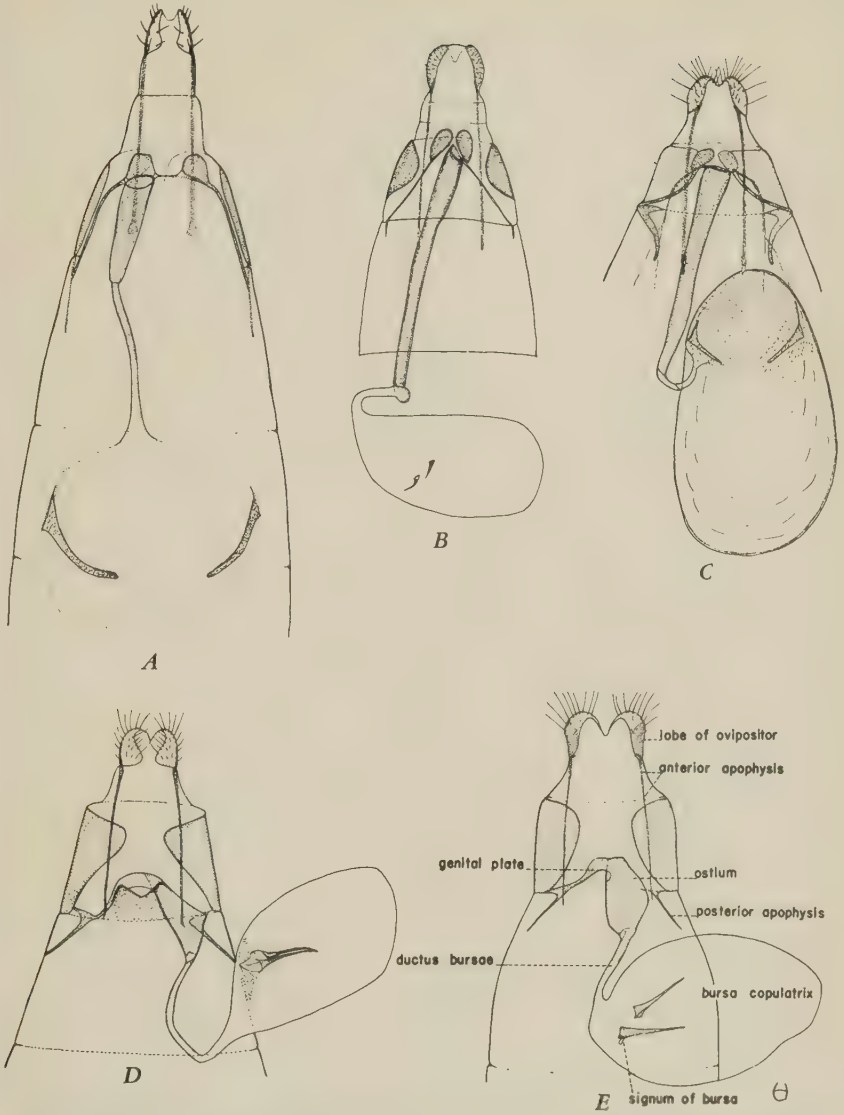


Plate 15. Female genitalia of *Platyptilia* species: *a*, *pallidactyla* (Haworth), England; *b*, *carduidactyla* (Riley); *c*, *percnodactyla* (Walsingham); *d*, *grandis* (Walsingham); *e*, *baueri* Lange, new sp.

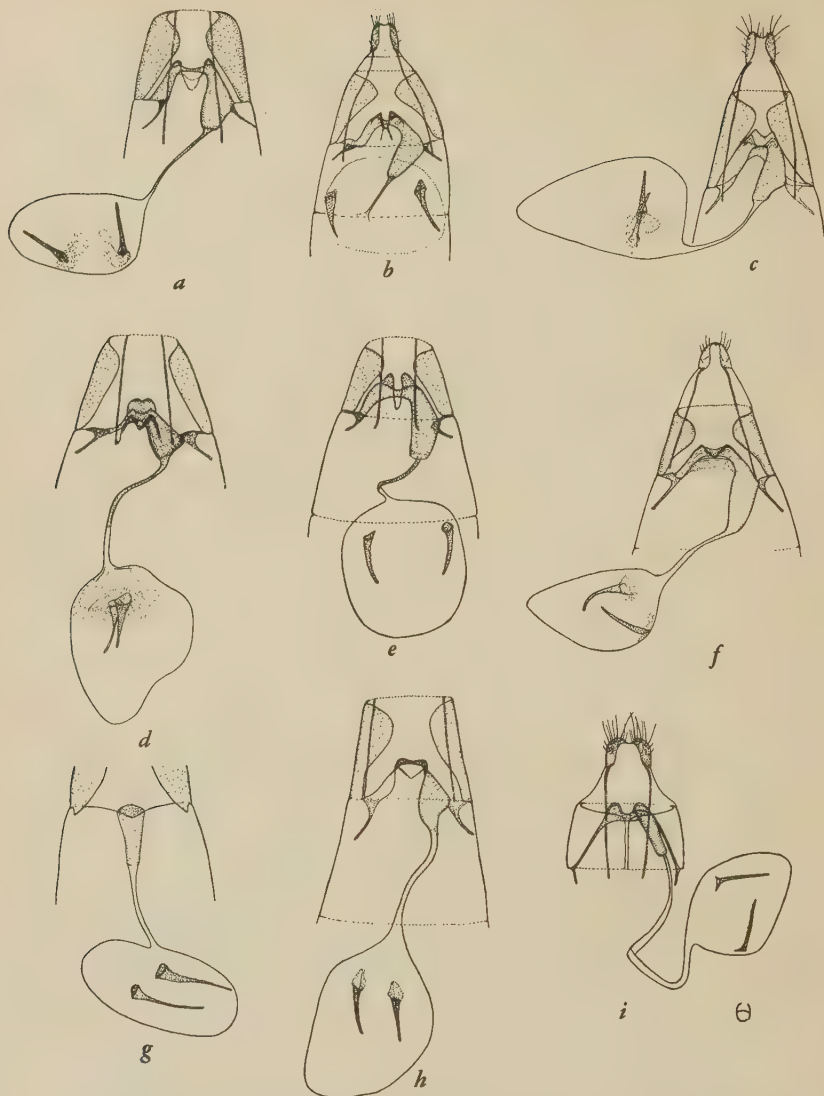


Plate 16. Female genitalia of *Platyptilia* species: *a*, *albiciliata albiciliata* (Walsingham); *b*, *shastae* (Walsingham); *c*, *lutescens* Lange, new sp.; *d*, *albida* (Walsingham); *e*, *albidorsella* (Walsingham); *f*, *cooleyi* Fernald (cotype); *g*, *antirrhina* Lange; *h*, *xylopsamma* Meyrick; *i*, *pica pica* (Walsingham), British Columbia.

